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AERONAUTICS

Includes aeronautics (general); aerodynamics; air transportation and safety; aircraft communications and navigation; aircraft design, testing and performance; aircraft instrumentation; aircraft propulsion and power; aircraft stability and control; and research and support facilities (air).

For related information see also *Astronautics*.

Each major division is further divided into as many as nine specific categories, which are identified by category numbers.

Abstracts in *STAR* are grouped by specific category, the categories appearing in sequential order. Category breaks in the abstract section are identified by the category number and title, and a scope note. Cross-references to other categories are provided as appropriate. For example:

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Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces; and internal flow in ducts and turbomachinery.

For related information see also *34 Fluid Mechanics and Heat Transfer*.

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CHEMISTRY AND MATERIALS

Includes chemistry and materials (general); composite materials; inorganic and physical chemistry; metallic materials; nonmetallic materials; and propellants and fuels.

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Includes space law; international law; international cooperation; and patent policy.

85 URBAN TECHNOLOGY AND TRANSPORTATION 406
Includes applications of space technology to urban problems; technology transfer; technology assessment; and surface and mass transportation.
For related information see *03 Air Transportation and Safety*, *16 Space Transportation*, and *44 Energy Production and Conversion*.

SPACE SCIENCES

Includes space sciences (general); astronomy; astrophysics; lunar and planetary exploration; solar physics; and space radiation.
For related information see also *Geosciences*.

88 SPACE SCIENCES (GENERAL) N.A.

89 ASTRONOMY 408
Includes radio and gamma-ray astronomy; celestial mechanics; and astrometry.

90 ASTROPHYSICS 408
Includes cosmology; and interstellar and interplanetary gases and dust.

91 LUNAR AND PLANETARY EXPLORATION 419
Includes planetology; and manned and unmanned flights.
For spacecraft design see *18 Spacecraft Design, Testing and Performance*. For space stations see *15 Launch Vehicles and Space Vehicles*.

92 SOLAR PHYSICS 419
Includes solar activity, solar flares, solar radiation and sunspots.

93 SPACE RADIATION 420
Includes cosmic radiation; and inner and outer earth's radiation belts.
For biological effects of radiation see *52 Aerospace Medicine*. For theory see *73 Nuclear and High-Energy Physics*.

GENERAL

99 GENERAL 420

Note: N.A. means that no abstracts were assigned to this category for this issue.

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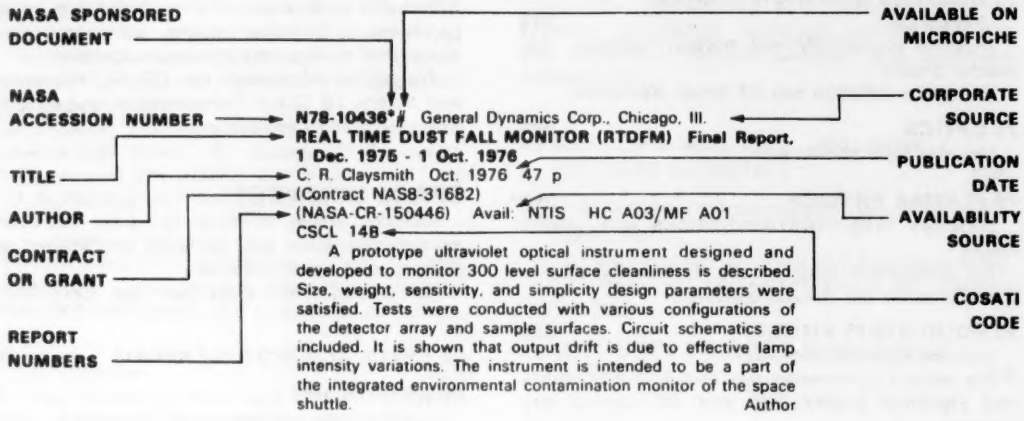
TYPICAL CITATION AND ABSTRACT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N78-10436*# General Dynamics Corp., Chicago, Ill.
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REAL TIME DUST FALL MONITOR (RTDFM) Final Report, 1 Dec. 1975 - 1 Oct. 1976
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REPORT NUMBERS
A prototype ultraviolet optical instrument designed and developed to monitor 300 level surface cleanliness is described. Size, weight, sensitivity, and simplicity design parameters were satisfied. Tests were conducted with various configurations of the detector array and sample surfaces. Circuit schematics are included. It is shown that output drift is due to effective lamp intensity variations. The instrument is intended to be a part of the integrated environmental contamination monitor of the space shuttle.
Author

ON-GOING RESEARCH PROJECTS

This is a listing of research projects – not publications

AERONAUTICS

Includes Aeronautics (general); Aerodynamics; Air Transportation and Safety; Aircraft Communications and Navigation; Aircraft Design, Testing, and Performance; Aircraft Instrumentation; Aircraft Propulsion and Power; Aircraft Stability and Control; and Research and Support Facilities (air). For Related Information See Also Astronautics.

1.0001, ANALYSIS OF A FREE-FLIGHT ROCKET LAUNCHER DESIGN CRITERION
J.E. COCHRAN, Auburn University, Engineering Experiment Station, *Auburn, Alabama* 36830 (DA0F1352)

To develop methods to estimate free-flight rocket systems impact dispersions. These methods will couple the launch phase errors to the free-flight errors in a manner usable by design engineers. Effects of rocket flexibility on the launch phase errors will be defined.

Models previously developed by Auburn University will be exercised, expanded and utilized to determine the causes and effects of launch phase errors on impact dispersions. Current models include rocket thrust misalignment and dynamic unbalance effects. The expanded models will include effects of rocket bending or flexibility on launch phase errors. The complex models will be simplified, while retaining the more significant errors sources, to a form readily usable by design engineers.

ADDENDA: Supporting agency address is: MIRADCOM GE&MS Directorate, Technology Laboratory, Redstone Arsenal AL 35809

SUPPORTED BY U.S. Dept. of Defense, Army

1.0002, EVALUATION OF A CIRCULATION CONTROL TAIL BOOM FOR YAW CONTROL
A.H. LOGAN, Hughes Aircraft Company, *Culver City, California* 90230 (DA0D4103; DAAJ02-77-C-0018)

To evaluate the ability of a circulation control tail boom to provide effective antitorque force over a typical helicopter flight regime.

A government-furnished OH-6A aircraft with an experimental tail boom which uses circulation control principles to produce an antitorque force will be modified and flight tested.

ADDENDA: Supporting agency address is: AVSCOM air Mobility R&D Lab, Eustis Dir, Ft Eustis VA 23604

SUPPORTED BY U.S. Dept. of Defense, Army

1.0003, AERONAUTICAL TECHNOLOGY, TECH AREA M - AVIATION HUMAN ENGINEERING
I.C. STATLER, U.S. Army, Air Mobility Res. & Dev. Lab., *Moffett Field, California* 94035 (DA0D5001)

Improve Army air mobility systems by providing improved knowledge, criteria and technology for man-machine integration and by providing better engineering methods for performing the AVSCOM man-machine integration functions.

Systematic exploratory R&D in human performance technology, flight simulation methods and requirements, control and display technology, and man-machine dynamics. The approach emphasizes analytical and experimental studies using laboratory, simulation, mathematical modeling and flight test facilities. These activities have been coordinated with and will complement and support the handling qualities R&D of technical area A and the flight simulator development of technical area K. Objectives will be achieved largely through joint participation with NASA, making maximum use of the facilities and expertise available within NASA for man-machine systems research.

ADDENDA: Supporting agency address is: AVRADCOM Air Mobility R&D Lab, Moffett Field CA 94035

SUPPORTED BY U.S. Dept. of Defense, Army

1.0004, IN-HOUSE LABORATORY INDEPENDENT RESEARCH PROGRAM (ILIR) - ROTOR ACOUSTIC RESEARCH
I.C. STATLER, U.S. Natl. Aero. & Space Adm., Ames Research Center, *Moffett Field, California* 94035 (DA0D5002)

The objective is to make maximum utilization of the information inherent in the radiated aerodynamically generated noise signature of rotors obtained by the newly developed in-flight noise measurement technique. These measurements provide noise pressure signals undistorted by reverberation, Doppler shift and other normally prevalent signal distortion mechanisms. These research efforts should provide the understanding of the noise generation mechanisms necessary to develop relatively simple mathmatical analysis which can be used for rotor noise source and radiation pattern prediction.

A combined experimental theoretical effort will be followed utilizing tools developed to separate the noise generation mechanisms and allow concentrated effort to solve the complex problems in a step-by-step fashion. The first effort will be to define the impulsive noise generation mechanism and provide theoretical prediction capability. The second phase will concentrate on the blade vortex interaction noise and determine influence of rotor blade geometric parameters on rotor noise. Model rotor experimental efforts will utilize the laser velocimeter and other techniques such as schlieren and shadowgraph to verify flow field disturbance patterns.

ADDENDA: Supporting agency address is: AVRADCOM Air Mobility R&D Lab, Ames Dir, Ames Research Center, Moffett Field CA 94035

SUPPORTED BY U.S. Dept. of Defense, Army

1.0005, MULTI-CALCULATION RATE SIMULATIONS
J.D. POWELL, Stanford University, School of Engineering, *Palo Alto, California* 94305 (NSG 2250)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

1.0006, FUNDAMENTAL STUDIES OF UNSTEADY TURBULENT BOUNDARY LAYERS
W.C. REYNOLDS, Stanford University, School of Engineering, *Palo Alto, California* 94305 (NSG 2258)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

1.0007, WIND TUNNEL INVESTIGATION OF THE AIRFLOW OF A MODEL HELICOPTER (ABBREV)
A.J. LANDGREBE, United Technologies Corp., *Hartford, Connecticut* 06108 (DA0F9013; DAAG29 77 C 0013)

To experimentally investigate helicopter rotor wakes for low forward speeds characteristic of current rocket firing tactics accounting for interference effects of the fuselage, wing, and the ground, and to utilize this data for determining analytically the velocity distributions along trajectories through the wake. Relevance -the research is directly relevant to the problem of a sight correction system on the AH-1G for the 2.75 in. rocket and to the problem of determining the correct position for a wind sensor. In addition, it is relevant to the determination of helicopter aerodynamic characteristics required in other investigations such as those associated with low-speed, terrain flying missions.

Rotor wakes produced by a combined model rotor-fuselage-wing will be examined and measured by means of both laser velocimeter and visualization techniques for determining the wake velocities and geometries, respectively. The results of the experimental program will provide velocity and wake geometry data for correlation with theory and for a systematic determination of the effects of aircraft components, ground effect, and significant flight parameters.

ADDENDA: Supporting agency address is: DARCOM US Army Research Office, Box 12211, Research Triangle Park NC 27709

SUPPORTED BY U.S. Dept. of Defense, Army

1.0008, RESEARCH IN AEROELASTICITY IN THE JOINT INSTITUTE FOR ADVANCEMENT OF FLIGHT SCIENCES AT THE NASA-LANGLEY RESEARCH CENTER
H. LIEBOWITZ, George Washington University, School of Engin. & Appl. Sci., *Washington, District of Columbia* 20037 (NSG 1438)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

1.0009, DEVELOPMENT OF METHODS FOR PREDICTING AND MEASURING DISTRIBUTION PATTERNS OF AERIAL SPRAYS
A.I. ORMSBEE, Univ. of Illinois, School of Engineering, *Urbana, Illinois* 61801 (NSG 1434)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

1.0010, FINITE-ELEMENT ANALYSIS OF CREEP AND THREE-DIMENSIONAL FRACTURE
T.H. PIAN, Mass. Inst. of Technology, School of Engineering, *Cambridge, Massachusetts* 02139 (DF048350; F49620-77-C-0084)

AF function - advanced flight vehicle structures and engine structures require improved design methods which accurately consider environmental conditions. Deficiency - accurate and efficient structural analysis methods do not exist which consider elevated temperature creep response. Objective - this research will investigate the propagation of structural defects under creep conditions. How work contributes -research will improve engine durability predictions.

This research will study the extension of hybrid finite-element methods for crack analysis to include creep phenomena. Crack extension studies will investigate the stress distribution and stress time histories at the crack front. Special elements will be developed to model correct stress singularity under creep conditions. Predictions of crack growth will be compared with experimental data found in the literature. In addition six problems will be solved which involve the prediction of stress intensity factors governed by three-dimensional behavior.

ADDENDA: Supporting agency address is: AF Office of Scientific Research NA, Bldg 410, Bolling AFB, DC 20332

SUPPORTED BY U.S. Dept. of Defense, Air Force

1.0011, MATH MODELING AND COMPUTER MECHANIZATION FOR REAL TIME SIMULATION OF ROTARY-WING AIRCRAFT
R.M. HOWE, Univ. of Michigan, School of Engineering, *Ann Arbor, Michigan* 48106 (NSG 2245)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

1.0012, SAFETY OF AIRPORT TERMINAL BAGGAGE LOCKER FACILITIES
UNKNOWN, U.S. Army, Waterways Experiment Station, *Vicksburg, Mississippi* 39180 (FATQWAI-651; FA59699 (TRAIS NO.))

Ojective are to (1) make a literature search and a canvass of civil government organizations to determine the most probable bomb materials, sizes, facility; (2) document and evaluate representative lockers and installations at a maximum of six airports. This effort shall determine what can be done quickly, easily, and practically to lockers and installation to defeat or minimize the bomb threat; (3) design prototype rooms and develop barriers to contain the effects of the explosions of bombs in stored baggage and lockers.

SUPPORTED BY U.S. Dept. of Transportation, Office of the Secretary

1.0013, APPLICATION OF COHERENT ANTISTOKES RAMAN SCATTERING TO LASER & COMBUSTION MEDIA
B.R. WON, Systems Research Labs. Inc., *Dayton, Ohio* 45432 (DF461250; F33615-77-C-2019)

Use coherent anti-Stokes Raman scattering (CARS) for measuring specie concentrations and temperature as a function of position inside a jet engine combustor.

Use the CARS system already demonstrated to obtain spectra for organic compounds found in fuels and combustion products, use CARS to determine specie concentrations vs. position within a combustion system.

ADDENDA: Supporting agency address is: AF Aero-Propulsion Laboratory SFF, Wright-Patterson AFB, Ohio 45433

SUPPORTED BY U.S. Dept. of Defense, Air Force

1.0014, EVALUATION OF ADVANCED MAINTENANCE PROCESSES ON THE C-5 AIRCRAFT GROUND SYSTEM
J.J. KLESCH, U.S. Air Force, Human Resources Laboratory, *Dayton, Ohio* 45433 (DF228320)

To modify the ground processing system (GPS), an advanced maintenance management system unique to C-5 aircraft, to incorporate twenty new maintenance management concepts, primarily in automation/distribution of existing maintenance forms and automated parts ordering. The changes will be incorporated incrementally into the GPS. An evaluation will be performed to determine the effectiveness of these changes in reducing administrative workloads, increasing visibility of management information and increasing overall operational effectiveness. Additionally, the modified system will be compared against a non-GPS maintenance system to enable evaluation for Air Force wide application. The specific objective of AFHRL's participation is to evaluate these concepts from a human factors standpoint (e.g., ease of use, confidence in system, training requirements) and to provide consultation in the design and execution of the overall evaluation.

New concepts will be implemented incrementally into the basic GPS and evaluated on the basis of operational impact and human factors. AFHRL will concentrate on the human factors investigation, to be accomplished by (1) assisting in task analysis, (2) identifying human factors evaluation areas, (3) developing job tests and data collection forms, (4) monitoring data collection, (5) analyzing human factors data, and (6) reporting findings. Manpower engineering teams will be the primary data collectors for both the human factors data, and the operational system evaluation data. To insure a valid assessment of change impact (resulting from automation), to be projected for other GPS and non-GPS applications, it is necessary to measure the same tasks in a similar but non-GPS system. The Mcguire AFB, C-

141 maintenance organization has been selected for this purpose. This effort will begin in February 1977 with evaluation of present system. Analysis and development of the proposed system will be accomplished as implemented by MAC. Total evaluation will be completed by January 1980. More detailed milestones can not be specified at this time. They will be specified as the effort progresses.

ADDENDA: Supporting agency address is: AF Human Resources Laboratory ASR, Wright-Patterson AFB, Ohio 45433

SUPPORTED BY U.S. Dept. of Defense, Air Force

1.0015, ACOUSTICS RESEARCH
R.M. SHIMOVETZ, U.S. Air Force, Flight Dynamics Lab., *Dayton, Ohio* 45433 (DF140680)

Various problems encountered in the development of AF weapon systems are related to the noise generated by the propulsion systems and pseudo-noise associated with flight through the atmosphere. These problems include degradation of the structural integrity, equipment reliability, crew health and performance, and aircraft survivability. The objective is to develop methods for the prediction and control of exterior and internal noise of military aircraft. The physical and geometric parameters of sources which are known, will be correlated to the characteristics of the noise and aeroacoustic fields and will accurately predict the spectra level, acoustic power, directivity, and correlation characteristics. These prediction methods will be in the form of design charts, computer programs, specifications, and acoustic and vibration criteria.

Existing methods of noise source estimation will be correlated into design charts and computer programs providing non acoustician users an easily computational means of obtaining near field noise estimates of aircraft sources. Vibration and acoustic levels on the X-24B pseudo noise will present the measurements and present prediction methods for boundary layer pressure oscillations. Weapons bay cavity pressure oscillation problem studies will be extended to publishing recent work in the flight test demonstration of suppression devices and slender cavities noise prediction for the ALBM (air-launched ballistic missile). YC-14 and YC-15 noise prediction efforts will include performing data and engineering analysis of the internal noise and STOL flap loads measuring programs which are contracted but may not be funded to complete the engineering analysis and report. Another area of this effort will be allocated to predicting the total radiated airframe acoustic power.

ADDENDA: Supporting agency address is: AF Flight Dynamics Laboratory FBED, Wright-Patterson AFB, Ohio 45433

SUPPORTED BY U.S. Dept. of Defense, Air Force

1.0016, AUTOMATED STRENGTH AND STIFFNESS DESIGN OF MILITARY AIRCRAFT
E.E. CWACH, General Dynamics Corporation, *Fort Worth, Texas* 76101 (DF138300; F33615-76-C-3118)

An essential design consideration for all high-performance military aircraft is the prevention of failures due to static and dynamic loading conditions. Efficient automated methods of design that include static and dynamic loading requirements are needed to reduce aircraft development time and increase structural reliability and operational effectiveness. The purpose of this effort is to transition an automated static and dynamic design procedure (FASTOP) for military aircraft structures to practical design environments and to determine the requirements for future automated design methods. These applications of FASTOP will allow the Air Force to expand the applicability of the FASTOP system, determine the requirements for future automated design procedures, and demonstrate how FASTOP can be integrated into a total aircraft design process.

The contractor will select and study a military aircraft design using the FASTOP system. Problem set-up times, program discrepancies, recommendations for improvements, and a discussion of the role FASTOP could play in an overall aircraft design system will be documented by the contractor.

ADDENDA: Supporting agency address is: AF Flight Dynamics Laboratory FBR, Wright-Patterson AFB, Ohio 45433

SUPPORTED BY U.S. Dept. of Defense, Air Force

1.0017, AAH CONCEPT FORMULATION STUDY, DEVICE 2B40
J. DICKMAN, Sperry Rand Corporation, *Fairfax, Virginia* 22030 (DA0S4995; N61339-77-C-0048)

Procure a concept formulation study to determine the optimum design of device 2B40, AH-64 flight & weapons simulator. It is desired that the study provide particular attention to the following areas: (A) Visual system (1) Provide day-night tactical terrain flight capability (2) Provide realistic simulation of: a. Visionic equipment b. Air-to-ground weapons delivery c. Target designation systems d. Enemy threat capabilities (3) Determine the optimum FOV to support typical AAH tactical operations. (B) Flight simulator (1) Evaluate the requirement for a motion system(s) and provide such systems as needed (2) provide a computer system that will include a minimum of 100 percent spare at the time of device delivery.

Award study contracts to three separate organizations to assure a broad spectrum of approaches to solving the problem.

ADDENDA: Supporting agency address is: DARCOM Project Manager for Training Devices, Naval Training Equipment Center, Orlando FL 32813

SUPPORTED BY U.S. Dept. of Defense, Army

1.0018, HYDRAZINE FUELED APU STARTER
L. GALBRAITH, Rocket Research Corporation, *Redmond, Washington* 98052 (DF459530; F33615-76-C-2148)

To develop a hydrazine fueled system to start gas turbine auxiliary power units (APU). This APU starter is expected to provide a true minus 65 degrees F start capability for aircraft APUs.

To minimize the cost of this effort only concept feasibility will be demonstrated. The first phase of this effort covered with the 55K of IDF will provide the system design. The remainder of the program will be used to develop and demonstrate the key components.

ADDENDA: Supporting agency address is: AF Aero-propulsion Laboratory POP, Wright-Patterson AFB, Ohio 45433

SUPPORTED BY U.S. Dept. of Defense, Air Force

1.0019, AIRPORT AND COMMUNITY NOISE DATA
UNKNOWN, U.S. Small Business Admin., *Seattle, Washington* 98104 (FA77WAI-723; FA59968 (TRAIS NO.))

SUPPORTED BY U.S. Dept. of Transportation, Office of the Secretary

CHEMISTRY AND MATERIALS

Includes Chemistry and Materials (general); Composite Materials; Inorganic and Physical Chemistry; Metallic Materials; Nonmetallic Materials; and Propellants and Fuels.

3.0001, FUNDAMENTAL STUDIES OF MOLECULAR RELAXATION AND COHERENT TRANSIENT EFFECTS
R.L. SHOEMAKER, Univ. of Arizona, School of Liberal Arts, *Tucson, Arizona* 85721 (CHE75-17834 A01)

Dr. Shoemaker intends to use coherent transient effects for several investigations of fast relaxation processes in molecular gases. These coherence effects, which include photon echoes, optical nutation, and optical free induction decay, allow one to make detailed, direct time domain measurements of relaxation processes. Coherent transient effects are normally difficult to control and observe using pulsed lasers, but may be easily seen using the Stark switching technique developed by R.G. Brewer and this investigator. In this method a cw laser is used and molecules are switched in and out of resonance using the Stark effect. High sensitivity and the ability to make accurate, repeatable measurements are thereby obtained. By using a combination of these coherence effects, fast relaxation processes such as rotational relaxation can be studied at a previously unobtainable level of detail. In particular, one can directly measure population lifetimes (T1), phase memory times (T2), and cross sections for velocity changing collisions within the Doppler profile. The average velocity change per collision can also be determined. Dr. Shoemaker will carry out experiments in five related areas: 1) Relaxation measurements will be made in an isolated non-

degenerate transition of NH2D which provides us with a model system to further refine our techniques; 2) Studies will be made of those relaxation processes as a function of molecular velocity which has not been done previously; 3) The Stark switching technique will be generalized to allow the study of nonpolar molecules by frequency switching the laser; 4) Accurate, direct measurements of transition dipole matrix elements will be attempted using optical nutation; and 5) An optical detection technique for infrared-microwave double resonance will be tried which should improve the sensitivity of these experiments.

SUPPORTED BY U.S. National Science Foundation, Div. of Chemistry

3.0002, FIRE BEHAVIOR - AIRCRAFT CABIN MATERIALS

C. HUGGETT, U.S. Dept. of Commerce, Natl. Bureau of Standards, *Washington, District of Columbia* 20234 (4914374 (NBS NO.))

PURPOSE: To improve the probability of preventing spread and growth of a fire and its combustion products, given a sustained ignition, by materials selection and passive design concepts.

OBJECTIVES: Define role of materials selection and configuration.

FY 77 MILESTONES: Collect or generate laboratory data on the fire properties of materials required by a time-dependent mathematical model, 10/76. Conduct simple experiments to verify predictions of the model, 11/76. Prepare final report, 1/77.

ACCOMPLISHMENTS: A simple model of the time-dependent growth of a fire in an aircraft cabin was developed, making use of laboratory-measurable fire properties of materials. The model relates the rates of development of hazard due to fire spread, temperature rise, and smoke and toxic gas generation, providing a basis for characterizing the hazard potential of a cabin interior configuration by a single combined hazard index (CHI).

SUPPORTED BY U.S. Dept. of Transportation, Federal Aviation Admin., Aircraft Development Service

3.0003, REACTIONS OF METASTABLE ATOMS AND MOLECULES

E.E. MUSCHLITZ, State University of Fla. Sys., School of Arts & Sciences, *Gainesville, Florida* 32601 (CHE76-17244 A01)

Dr. Muschlitz will continue experimental research on transfer of electronic excitation energy in molecular collisions using molecular beams, optical, and mass spectrometric techniques (currently supported by NSF Grant GP-30846X). In particular, more precise determination of the velocity dependence of absolute cross sections for Penning and association ionization will be made for reactions of state selected beams of helium metastable atoms with various gases. New molecular beam investigations will be made of the velocity dependence of fluorescence following electronic energy transfer in collisions of metastable rare gas atoms. In particular, the vibrational energy distribution of product species will be determined by spectroscopic analysis of the emitted light. The results of these experiments would provide detailed answers concerning the mechanism of these bimolecular energy transfer processes which are of considerable importance in our understanding of upper atmosphere phenomena and the mechanism of laser action.

SUPPORTED BY U.S. National Science Foundation, Div. of Chemistry

3.0004, LASER-INDUCED CHEMISTRY AND ENERGY TRANSFER STUDIES IN SMALL MOLECULES

E. WEITZ, Northwestern University, School of Arts & Sciences, *Evanston, Illinois* 60201 (CHE76-10333 A01)

SUPPORTED BY U.S. National Science Foundation, Div. of Chemistry

3.0005, MATERIALS FOR IR TRANSMISSIVE OPTIC MATERIALS

N.J. GRANT, Mass. Inst. of Technology, School of Engineering, *Cambridge, Massachusetts* 02139 (DF900830; F19628-75-C-0191)

AF function - development and improvement of windows for ir laser systems. Deficiency - structural defects and mechanical strengths limit the viability and operational capability of materials used for windows in ir laser systems. Objective - to determine the relationship between processing variables, hardenability, microstructure, fracture mechanics, and optical performance of ir window materials. How research contributes - this research will provide processing and characterization data for the design of improved windows for laser systems.

Theoretical and experimental studies will be made of the process variables and defect distribution and their relationship to strength properties, microstructure stability, fracture strength, and degree of polygonization in alkali halide crystals, alkaline earth crystals and other materials appropriate to ir transmissive optics. The processing parameters and the resultant properties of these materials is of critical importance to advanced AF systems.

ADDENDA: Supporting agency address is: Rome Air Development Center ETS, Griffiss AFB, N Y 13440

SUPPORTED BY U.S. Dept. of Defense, Air Force

3.0006, PHOTOIONIZATION AND PHOTOCONDUCTIVITY IN MOLECULAR MATERIALS

C.L. BRAUN, Dartmouth College, School of Arts & Sciences, *Hanover, New Hampshire* 03755 (DMR77-00318)

The Principal Investigator continues his study of photoionization and photoconduction including work on liquid insulators as well as solids. A more detailed picture of photoionization, geminate charge recombination, and photoconductivity in condensed phase materials is being developed. There are three principal goals: 1. To determine the primary quantum yield of photoionization for several molecules (e.g., benzene) as a function of excitation wavelength using high electric fields and fluorescence quenching as complementary probes. 2. To use Onsager theory to determine the distribution function of separation distances between just-thermalized electrons and their parent positive ions for a number of solutes, solvents and photon energies. 3. To understand the origins of photoconductivity near threshold energy. Spectroscopic observation of Wannier exciton series will be important in this effort.

This work should have practical significance for the understanding of quantum efficiency limitations of photoconductive devices and organic photovoltaic cells.

This is a continuation of research support under DMR72-03035.

SUPPORTED BY U.S. National Science Foundation, Div. of Materials Research

3.0007, STUDIES OF THE ENERGY STATE OF PRODUCTS OF HETEROGENEOUS REACTIONS ON WELL-CHARACTERIZED METAL SURFACES

S.L. BERNASEK, Princeton University, Graduate School, *Princeton, New Jersey* 08540 (CHE77-03678)

Experimental studies are designed to determine the energy state of heterogeneous reaction products following reaction on well-characterized metal surfaces. Initial work will concentrate on the determination of the rotational state distribution of hydrogen molecules leaving a surface after hydrogen atom recombination. A gas dynamic diagnostic tool, electron beam induced fluorescence, is used for this rotational state determination. Extension of the methods described here to other heterogeneous systems and to the determination of translational and vibrational product energy state distributions is planned. These studies will add significantly to a detailed understanding of the reaction dynamics of simple heterogeneous reactions. Such understanding is essential to basic research in catalysis, and provides a test of theoretical treatment of adsorption. Results of this investigation could also provide an experimental test of theories which attempt to explain the observation of rotationally excited hydrogen molecules in the interstellar medium.

SUPPORTED BY U.S. National Science Foundation, Div. of Chemistry

3.0008, VAPORIZATION AND COMBUSTION OF MULTICOMPONENT FUEL DROPLETS
W.A. SIRIGNANO, Princeton University, School of Engin. & Appl. Sci., *Princeton, New Jersey* 08540 (ENG76-81253)

A theoretical model of multicomponent fuel droplet vaporization and combustion will be developed. Transport phenomena will be included with particular emphasis on the fluid mechanical aspect of generation of internal circulation by relative velocity between the droplet and the ambient gas. The effect of internal circulation on the bulk combustion process will be investigated. The model will be tested by experimental measurements. Two-component alcohol droplets of small size (100cm) will be collected from a high-speed (1000-5000 cm/s), high-temperature (300 K -1000 K), laminar gas flow. The droplet collection probe must allow separation of liquid-phase droplets from the surrounding gas-phase. The efficiency of the probe will be investigated by seeding the gas flow with methane -- very little methane should be found in the probe carrier gas. Rates of change of droplet composition will be determined experimentally as a function of gas velocity, oxygen concentration, and temperature. The study will provide a model which is more relevant to droplet vaporization and combustion in fuel sprays than the droplet combustion models which assume spherical symmetry, single-component fuel, and constant droplet properties. The model to be developed will impact the models of combustion in fuel sprays in systems such as diesel engines, gas turbines, and furnaces.

SUPPORTED BY U.S. National Science Foundation, Div. of Engineering

3.0009, EFFECTS OF MOISTURE AND TEMPERATURE ON POLYMER-MATRIX COMPOSITES 15183-MS
J.C. HURT, Univ. of North Carolina, School of Engineering, *Raleigh, North Carolina* 27607 (DA0F8987; DAAG29 77 G0124)

To study the mechanisms of degradation of polymer-based fiber-reinforced composites in the presence of moisture and moderately high temperatures. Relevance - this research is relevant to the performance of polymer matrix composites for applications such as helicopter components (e.g. rotor blades and fuselage panels), personnel armor, tank wheels, missile motor cases, rocket launch tubes, and electronic circuit boards. The environmental degradation of polymer matrix composites has been referred to as the Army's number-one problem in the area of composites.

The study will include: (1) experimental determination of the temperature- and moisture-dependent mechanical properties of the constituent polymers and fibers, as well as the composites; (2) determination of the absorption and diffusion coefficients for moisture in the constituent resin and fibers; (3) determination of the mechanisms of interaction of the moisture with the composite; (4) development of a micromechanical model to describe the elastic and elastic-plastic behavior of the composite.

ADDEDNA: Supporting agency address is: Darcom Army Research Office, Box 12211, Research Triangle Park NC 27709

SUPPORTED BY U.S. Dept. of Defense, Army

3.0010, HALOGENATION REACTIONS OF GROUP IB ATOMS USING MOLECULAR BEAMS AND SPECTROSCOPIC DETECTION
J.M. PARSON, Ohio State University, School of Math. & Phys. Scis., *Columbus, Ohio* 43210 (CHE76-11641 A01)

Dr. Parson will use a crossed molecular-beam to study reactions of IB atoms with halogens and hydrogen halides. The methods of chemiluminescence and laser-induced fluorescence of product molecules will be used for detection. Quantities to be measured are translational energy dependence of cross sections, internal energy distributions of products, angular distributions of products, and absolute cross sections. Special features in the experimental approach include using metastable atomic beams, a secondary beam nozzle source, rotation of the laser light path about the collision center, background light correction by beam modulation, and high-repetition-rate laser pulses for enhanced signal. Emphasis will be on A plus BC reaction types where there are good opportunities for comparison of experimental results with theoretical predictions from potential energy surfaces. Other more immediate objectives involve identification of types of reactants which lead to inverted populations in vibrational or electronic degrees of freedom.

SUPPORTED BY U.S. National Science Foundation, Div. of Chemistry

3.0011, EVALUATION OF SURFACE ALIGNMENT MECHANISMS FOR NEMATIC LIQUID CRYSTALS
D.L. JOHNSON, Kent State University, School of Arts & Sciences, *Kent, Ohio* 44242 (NSG 3159)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

3.0012, GROUP THEORETIC CLASSIFICATION OF ATOMIC AND MOLECULAR PROCESSES
D.R. HERRICK, Oregon State Higher Educ. Sys., School of Liberal Arts, *Eugene, Oregon* 97401 (CHE76-10332)

This theoretical research program will focus on new group theoretic methods for (a) classifications and predictions of multiply excited atomic and molecular spectra selection rules, energy level orderings, and scattering resonance widths from Lie algebra applications to many-electron systems, (b) a renormalization group type theory for calculating electronic binding energies and metastable state lifetimes from dimensionality expansions of the correlation energy, and (c) classical trajectory descriptions of doubly excited helium with applications to the theory of nonergodicity for many-particle systems.

SUPPORTED BY U.S. National Science Foundation, Div. of Chemistry

3.0013, HIGH-ENERGY-DENSITY ELECTRODES FOR ALKALI-METAL BATTERY SYSTEMS
W.L. WORRELL, Univ. of Pennsylvania, School of Metallurgy, *Philadelphia, Pennsylvania* 19104 (DF048880; AF-AFOSR-3319-77)

AF function - certain power requirements within the Air Force, such as in aircraft conventional weapons and munitions, are best satisfied by the use of conventional battery systems. Opportunity - at present, one of the most promising high-energy-density batteries being developed is the lithium-sulphur battery. The energy-density of this battery can be increased significantly by developing new solid-state positive electrodes. Objective - the objective of this work is to develop the alkali-metal intercalated dichalogenides as electrodes for high-energy-density battery systems. How work contributes - this work will contribute to the state-of-the-art in battery systems by developing electrodes which could increase the energy density of the lithium-sulphur battery by a factor of two.

Techniques for preparing the alkali-metal intercalated dichalogenides are now being developed. For example, commerical TaS2 powder is annealed in order to form stoichiometric TaS2 in a form which can then easily intercalate lithium or sodium which are introduced with organic solutions. Electrochemical behavior of these prepared cathodes will be examined by placing them in an alkali battery system. The open circuit voltage measurements will be used to determine the chemical potential of the alkali constituent in the electrode. The diffusivity of the alkali within the electrode will be measured by techniques such as the potentiostatic method, the pulse-relaxation technique, or through the measurement of transient voltages.

ADDENDA: Supporting agency address is: AF Office of Scientific Research NE, Bldg 410, Bolling AFB, DC 20332

SUPPORTED BY U.S. Dept. of Defense, Air Force

3.0014, CROSSED BEAM STUDIES OF EXCITED ATOM COLLISIONS
P.E. SISKA, Univ. of Pittsburgh, School of Arts & Sciences, *Pittsburgh, Pennsylvania* 15260 (CHE76-84434)

A continuation of the study of metastable rare-gas atom collisions in crossed molecular beams, currently supported by Foundation grant CHE-7403072, is planned. Time-of-flight experiments will allow the measurement of state-to-state absolute differential cross sections for electronic excitation transfer processes in a number of systems. Angle-energy distribution measurements for Penning ionization systems will continue, and they will be extended to include open-shell atom partners and halogen-containing molecules. Elastic scattering in nonquenching metastable atom systems is planned as a means of obtaining unambiguous information on excited-state potentials. Differential scattering measurements in H, N, and O atom systems also will be carried out.

SUPPORTED BY U.S. National Science Foundation, Div. of Chemistry

3.0015, A STUDY OF LOCALIZED PLASTIC DEFORMATION AS RELATED TO FATIGUE MECHANISMS
R.J. ASARO, Brown University, Graduate School, *Providence, Rhode Island* 02912 (DF047680; AF-AFOSR-3246-77)

AF function - certain high-strength structural materials used in aerospace systems (including some aluminum and titanium alloys) are susceptible to the occurrence of strain localization. Opportunity - this phenomenon is due to the development of localized regions which are plastically unstable, and results in severe reductions in fatigue life and ductility. The process is particularly insidious since critical strain for fracture can be locally surpassed at very low average macroscopic strain, thus leading to unexpected premature failure. Objective - this research will: (1) identify the experimental conditions which cause plastic deformation of homogeneous bodies to become localized into intense shear bands, (2) ascertain to what extent these bands cause material damage, crack initiation or contribute to crack growth, and (3) analyze the initiation of plastic localization both as an abrupt degradation or weakening of the material and also as an instability in the constitutive description of plastic flow. How work contributes - this fundamental study will investigate localized plastic deformation, and the role it plays in fatigue mechanisms, metal ductility, and fracture processes.

Experiments will be performed on single crystals and axisymmetric polycrystalline specimens of aluminum-copper alloys in order to precisely document the conditions of stress state, strain rate, work hardening rate, temperature and metallurgical structure which allow localization of plastic flow to occur. Subsequent studies will include 2000 and 7000 series commercial aluminum alloys.

ADDENDA: Supporting agency address is: AF Office of Scientific Research NE, Bldg 410, Bolling AFB, DC 20332

SUPPORTED BY U.S. Dept. of Defense, Air Force

3.0016, DEVELOPMENT OF METAL LAMINATE SYSTEMS
R.D. GOOLSBY, Advanced Technology Ctr. Inc., *Dallas, Texas* 75222 (DN790031; N00019-77-C-0287)

Develop metal laminate systems for air structural applications.

Explore titanium and aluminum laminate combinations bonded by: brazing, weld bonding, explosive bonding.

ADDENDA: Supporting agency address is: Naval Air Systems Command, Washington, DC 20360

SUPPORTED BY U.S. Dept. of Defense, Navy

ENGINEERING

Includes Engineering (general); Communications; Electronics and Electrical Engineering; Fluid Mechanics and Heat Transfer; Instrumentation and Photography; Lasers and Masers; Mechanical Engineering; Quality Assurance and Reliability; and Structural Mechanics. For Related Information See Also Physics.

4.0001, TECHNICAL IMPACT OF NAVAIR ELECTRONICS RESEARCH
R.F. POTTER, Unknown Inst. or Indiv. Grant, *California* (DN790002; N00019-77-M-0222)

To assess the technical impact of the Electronics Research Program of the Naval Air Systems Command.

Theoretical study.

ADDENDA: Supporting agency address is: Naval Air Systems Command, Washington, DC 20360

SUPPORTED BY U.S. Dept. of Defense, Navy

4.0002, ELECTRIC DISCHARGE TECHNIQUES FOR IMPROVED PERFORMANCE OF LASERS
W.P. BURCKELL, Northrop Corporation, *Hawthorne, California* 90250 (DF191600; F29601-76-C-0129)

Perform analytical and experimental investigations on new electric discharge concepts which have the potential of significantly improved performance over current lasers. These advanced techniques will be applied to high-energy laser gases such as carbon dioxide and carbon monoxide. Of primary interest will be the non e-beam approaches to electric discharges.

(1) A photoionization experiment will investigate the use of sparks to produce photoionization of the laser gases under various discharge conditions which may eliminate the need for ionization from complex electron guns. (2) Controlled avalanche discharge experiments will be carried out in static laser gases to investigate energy loading by this technique. (3) Experiments in flowing gas systems, both subsonic and supersonic, will be carried out to determine if the above techniques are feasible with flow and what the subsequent laser performance is.

ADDENDA: Supporting agency address is: AF Weapons Laboratory ALE, Kirtland AFB, N Mex 87117

SUPPORTED BY U.S. Dept. of Defense, Air Force

4.0003, INVESTIGATION OF DATCOM PREDICTION METHODS
C.R. BAUER, McDonnell Douglas Corporation, *Long Beach, California* 90808 (DF139630; F33615-77-C-3034)

A continuing effort is required to improve DATCOM coverage by refining existing methods and adding new techniques in concert with rapidly advancing technology. The objective of the present effort is to conduct a comprehensive review of the DATCOM and related aerodynamic technology, both to uncover deficiencies and imbalances in current DATCOM coverage and to gain information for efficiently planning future exploratory development.

The approach will consist of (1) a detailed, section-by-section review of the DATCOM to isolate errors and identify shortcomings and omissions in current coverage, (2) an investigation and evaluation of specific techniques for predicting the aerodynamics of missiles and the high-lift characteristics of close-coupled canards, and (3) the identification of other areas which appear to be amenable to solution at the present time, based on a survey of aerodynamic methods and data in the currently available literature.

ADDENDA: Supporting agency address is: AF Flight Dynamics Laboratory FGC, Wright-Patterson AFB, Ohio 45433

SUPPORTED BY U.S. Dept. of Defense, Air Force

4.0004, PVF2 TRANSDUCERS FOR NONDESTRUCTIVE EVALUATION OF CERAMICS AND BRITTLE MATERIALS
H.J. SHAW, Stanford University, W.W. Hansen Lab. of Physics, *Palo Alto, California* 94305 (DF049450; AF-AFOSR-3386-77)

AF function - ceramic materials are being developed for a variety of components (e.g. blades, vanes, combustors, bearings and seals) in future gas turbine engines and for a variety of electronic and optical components in aircraft. Because ceramics and new brittle metal alloys fail catastrophically from pre-existing flaws or cracks, new nondestructive evaluation, NDE, techniques are required to locate and reject these defects. Opportunity - an important new material, polyvilidene fluoride (PVF2), has been found to have properties particularly suitable for operation as a high-frequency ultrasonic transducer. Objective - this research

seeks to understand and develop the utilization of PVF2 for application to NDE of ceramics and brittle metals. How work contributes - high frequency, and flexible geometry will allow flaw detection on complex geometries such as turbine blades.

This research will develop the theory, the optimum geometrical configuration and the design curves for PVF2, multilayer transducers. The desired insertion loss, bandwidth and acoustic beam shape will be optimized for the excitation of bulk and surface waves.

ADDENDA: Supporting agency address is: AF Office of Scientific Research NE, Bldg 410, Bolling AFB, DC 20332

SUPPORTED BY U.S. Dept. of Defense, Air Force

4.0005, IMPROVED MEASUREMENT METHODS FOR LONG DISTANCES

P.L. BENDER, U.S. Dept. of Commerce, Natl. Bureau of Standards, *Boulder, Colorado* 80302 (2741162)

PURPOSE: To improve measurement capability for distances of tens of meters and longer outside the laboratory, as needed in support of U.S. science, technology, and the programs of many government agencies.

OBJECTIVES: To study the effectiveness of improved distance measurements to planetary orbiters and landers for determining the motion of the inner planets; to investigate the relative merits for geodynamics applications other than earthquake prediction of laser range measurements to the LAGEOS satellite, very long baseline microwave interferometry, and improved ground or aircraft techniques; to demonstrate the usefulness of accurate Earth-Moon distance measurements for determining very long standard baselines, polar motion, nutation, and the Earth's rotation; to study the ultimate limitations on measuring strains with periods of minutes to hours.

FY77 MILESTONES: (a) Revise and publish paper on analysis of Earth-Mercury Orbiter distance measurements, Sept., 1977. (b) Write paper on new measurement techniques for geodynamics, June, 1977. (c) Prepare for publication study of accuracy for long standard base line determined by transportable lunar ranging station, June, 1977. (d) Complete article on atmospheric corrections to lunar laser distance measurements, June, 1977. (e) Contributè to improved modeling of ocean loading effects on geocentric positions of geodetic reference points, Sept., 1977.

SUPPORTED BY U.S. Dept. of Commerce, National Bureau of Standards

4.0006, STUDY OF FLEXIBLE BODY INTERACTION

A.K. CHOUDHURY, Howard University, Graduate School, *Washington, District of Columbia* 20001 (NAS 5-24251)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

4.0007, EQUIPMENT - LASER DOPPLER VELOCIMETER FOR FLUID MECHANICS AND HEAT AND MASS TRANSFER RESEARCH

V.G. HARRIS, Howard University, School of Engineering, *Washington, District of Columbia* 20001 (ENG76-84531)

This grant is for the purchase of a Laser-Doppler Velocimeter to be used in fluid mechanics, heat and mass transfer research. Specifically, some of the problems of current interest are: 1. Turbulent Structure Modeling. The investigation would be an effort to obtain the various structure functions in high-Rayleigh-number turbulent flows in naturally convecting enclosures. The LDV will be used to eliminate probe interference and the ambiguity of sensor signals typical of hot-wire anemometry measurements in turbulent flows with heat transfer. 2. Unsteady Boundary Layers and Boundary Layers with Heat and/or Mass Transfer. The LDV will permit resolution of flow velocity near the boundary, directionally as well as temporally, allowing experimental corroboration of theoretical results for reversing unsteady boundary layers. 3. Flow Studies of the Arterial Type in Fixed, Compliant and Branching Channels. The objective is the resolution of fluid velocity near the wall region in pulsatile flows for frequency parameter 1 less than or equal to R/omega/nu less than or equal to 10, with specified channel boundary conditions, focusing on the detection of stagnation regions, separated flows and regions of high wall shear.

SUPPORTED BY U.S. National Science Foundation, Div. of Engineering

4.0008, PARACHUTE CANOPY STRESS MEASUREMENT

G. BRAUN, D F V L R Flughafen, *West Germany, Federal Republic of Germany* (DF140080; AF-AFOSR-3261-77)

Current design practices for textile-type canopies used in parachute recovery systems for unmanned and manned flight vehicles incorporate amplification factors to account for dynamic occurrences during the parachute opening process. As a result, parachute canopies are relatively heavy and bulky due to required materials strength, and are subject to failure under overload conditions due to insufficient knowledge for the selection of experience-based amplification factors. The objective of the program is the direct measurement of cloth stresses at selected locations on parachute canopies during free flight for the correlation of the acquired data to analytical predictions and comparison with wind-tunnel test results. The resulting data will be normalized for the establishment of design relationships which will aid in the selection of lightweight materials and their effective distribution within the canopy commensurate with the expected stress values. Lighter weight canopies and more reliable performance during the critical phase of parachute operation will result.

Free-flight tests of scale-model ringslot canopies shall be accomplished utilizing the Braunschweig air pressure cannon test facility. The test canopies shall be instrumental with 'omega' stress transducers, which have undergone static and dynamic calibrations. Measurements during the test will provide data for correlation of canopy stresses, opening force, velocity and instantaneous shape.

ADDENDA: Supporting agency address is: AF Flight Dynamics Laboratory FER, Wright-Patterson AFB, Ohio 45433

SUPPORTED BY U.S. Dept. of Defense, Air Force

4.0009, TRANSONIC AERODYNAMICS RESEARCH

R.A. GROW, U.S. Air Force, Armament Test Laboratory, *Eglin Air Force Base, Florida* 32542 (DF643200)

This work unit will support store separation analysis. The major area to be addressed by this work unit is the analytical prediction of aerodynamic forces under transonic conditions. The purpose of this work unit is to perform in-house transonic aerodynamic research to increase the AFATL/DLJC capability for analyzing store separation aerodynamics in transonic flight regimes. The technique developed by this work unit will decrease the cost of determining store/aircraft compatibility.

The principal investigator shall perform studies and theoretical investigation to identify the state-of-the-art of transonic aerodynamics and store separation analysis. He shall plan, coordinate, and monitor wind-tunnel tests to verify the analytical techniques identified through the state-of-the-art investigation.

ADDENDA: Supporting agency address is: AF Armament Laboratory DLJC, Eglin AFB, FLA 32542

SUPPORTED BY U.S. Dept. of Defense, Air Force

4.0010, A JOINT PROJECT FOR STUDY OF CYLINDRICAL FRESNEL LENS AS A SOLAR CONCENTRATOR

UNKNOWN, Ball State University, Graduate School, *Muncie, Indiana* 47306 (NCA 8-129)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

4.0011, FINITE ELEMENTS FOR FLUID DYNAMICS

N. GEFFEN, Tel Aviv University, *Ramat Aviv, Tel Aviv, Israel* (DF048990; AF-AFOSR-3345-77)

Af function - aerospace vehicles. Opportunity - both present and future Air Force aerospace vehicles will be required to fly at high speeds and have an ability to maneuver at all speeds. This will require that new and improved engineering design and analy-

sis methods be developed throughout the total speed regime for the precise engineering determination of the performance and system capabilities of these vehicles. Objective - this research will attempt to develop new methods for fluid dynamical analysis using high-speed computers, methods which circumvent the disadvantages of currently employed machine algorithms. How work contributes - the ability to perform aerodynamic calculations about complex (real) shapes using finite-element methods which are becoming standard in structural analysis could lead to great improvements in efficient use of computers as engineering design and analysis tools. Resolutions of the variational problems underlying the use of such finite-elements will do much to bolster engineering confidence in the (numerical) finite-element methods, thereby giving the engineer an added and vital tool for use in predicting the 'grand ensemble' vehicle flow field.

This research will investigate the possibility and feasibility of using variational formulations to obtain finite-element analysis and procedures for the solution of quasilinear hyperbolic and mixed initial value problems, with application to unsteady flow about bodies, time dependent simulation of aerodynamic phenomena in all speed ranges, steady transonic flows (including the case of the super-critical wing) and to internal gasdynamic flows (e.g. cascades and inlets).

ADDENDA: Supporting agency address is: AF Office of Scientific Research NA, Bldg 410, Bolling AFB, DC 20332

SUPPORTED BY U.S. Dept. of Defense, Air Force

4.0012, INVESTIGATION OF THE ELECTROMAGNETIC SHIELDING CHARACTERISTICS OF COMPOSITE STRUCTURES (ABBREV)

G. BECHTOLD, U.S. Navy, Surface Weapons Center, *Silver Spring, Maryland* 20910 (DN785004)

To develop the relationship between the electromagnetic pulse and other shielding (p static, lightning, EMI) required for the F18, AV8B, and other future aircraft employing composite structures in a complex electromagnetic environment.

NSWC will provide expertise to NavAir in the field of EMP and other electromagnetic techniques to support studies of electromagnetic shielding properties of composite structures. To develop the techniques required for the effective development of composites NSWC will a. monitor NavAir contractors, b. Coordinate with industry, the Air Force, Army, NATC, the F18 projects. NSWC will also monitor research activities related to high-energy effects on composite structures and will conduct tests and analyses on composite materials.

ADDENDA: Supporting agency address is: Naval Air Systems Command, Washington, DC 20360

SUPPORTED BY U.S. Dept. of Defense, Navy

4.0013, INTRUDER DETECTION FEASIBILITY STUDY

S.J. ROCHEFORT, Northeastern University, School of Engineering, *Boston, Massachusetts* 02115 (DF903050; F19628-77-C-0142)

AF function - security. Deficiency - need to protect entities such as airplanes, airbases, airstrips and vehicles. Objective - to develop a radio frequency intruder detection system. How research contributes -the r.f. detection system will be adaptable to use by any other government agency, military and nonmilitary.

The investigation consists of three phases: 1) a theoretical study on the scattering and absorption of electromagnetic energy by humans; 2) a laboratory and field experiment to validate theoretical conclusions and gather preliminary experimental data; 3) a full-scale field experiment of the entire detection system. Not only will the system be tested for its response to human intrusion but also its reaction to false alarm triggering by physical, electrical and environmental conditions. Concurrently with the field tests will be development of the received signal processing portion of the overall system.

ADDENDA: Supporting agency address is: Rome Air Development Center ETE, Griffiss AFB, N Y 13440

SUPPORTED BY U.S. Dept. of Defense, Air Force

4.0014, NETWORK OPERATING SYSTEM STUDY

UNKNOWN, Bolt Beranek & Newman Inc., *Cambridge, Massachusetts* 02138 (DF728240; F30602-76-C-0425)

The objective of this effort is to continue effort begun under contract F30602-75-C-0222 and to examine processor-to-processor communication and critical functions which are basic to a network operating system.

A design for a remote read/write function will be produced and an implementation to demonstrate feasibility will be completed under Multics or Tenex.

ADDENDA: Supporting agency address is: Rome Air Development Center ISC, Griffiss AFB, N Y 13440

SUPPORTED BY U.S. Dept. of Defense, Air Force

4.0015, STOCHASTIC AND ADAPTIVE SYSTEMS

M. ATHANS, Mass. Inst. of Technology, School of Engineering, *Cambridge, Massachusetts* 02139 (DF047360; AF-AFOSR-3281-77)

AF function - develop models and control systems for aircraft systems and their subsystems. Deficiency - the control of future aircraft that operate in a diverse environment. Objective - the objective of this proposal is to design stability augmentation systems and control systems that operate reliably over a wide operating envelope. How work contributes - success in the pursuit of this objective would enable engineers to design more accurate and more reliable controllers for use in important Air Force aircraft systems.

The problems of stochastic and adaptive systems will be investigated through five areas of research. The first area deals with modeling and realization theory for stochastic systems. A fundamental contribution of this work will be correct definitions of stochastic reachability and stochastic observability. The second area will be concerned with identifiability and detectability of stochastic processes with application to dynamic system identification. The third area will be the studies in the nonlinear filtering theory of optimal and suboptimal estimations for systems possessing special algebraic structure and the optimal estimation for systems with time delays. The fourth area of research will be the extension of the geometric theory of linear multivariable control to stochastic situations. This research will be applied to stochastic control laws implemented by finite-state sequential machines, singular stochastic control problems and dual compensator structures, and stochastic control of coupled systems. Finally, the last area of research will be adaptive stochastic control with a long-range goal of attempting to combine the robustness results with the white-noise results so as to obtain at the very least some bounds on the improvement in performance by adaptive control, which would serve as a basis for dual control suboptimal adaptive control algorithms with less stringent computational requirements.

ADDENDA: Supporting agency address is: AF Office of Scientific Research NM, Bldg 410, Bolling AFB, DC 20332

SUPPORTED BY U.S. Dept. of Defense, Air Force

4.0016, OFF-DESIGN WAVERIDER FLOW FIELDS

J.R. BARON, Mass. Inst. of Technology, School of Engineering, *Cambridge, Massachusetts* 02139 (DF048600; F49620-77-C-0090)

AF function - aerospace vehicles. Opportunity - waveriders are a special class of vehicles which utilize favorable interference in their optimization. Such optimization of favorable interference is generally 'point-optimal' design and off-design performance can degrade to the point of prohibiting the use of the concept. This effort proposes to concentrate on the off-design flow fields of this rather elemental geometry vehicle and thereby provide insight into the off-design behavior, not only of the waverider concept, but of favorable interference phenomena in general. Objective - develop a method which is capable of accounting for the off-design behavior of a generalized waverider configuration. How work contributes - this study is concerned with how to control the enhanced interference effects that are known to be achievable with finite span geometries in so-called on-design situations. The focus of this effort is on flow field behavior and predictions. From such information performance changes should be apparent when there is a departure from the ideal (on-design) condition.

A theoretical evaluation of inviscid flow fields for off-design waverider configurations. The sensitivity of off-design behavior to both flow and geometric parameters will be sought as a measure of overall waverider performance.

ADDENDA: Supporting agency address is: AF Office of Scientific Research NA, Bldg 410, Bolling AFB, DC 20332

SUPPORTED BY U.S. Dept. of Defense, Air Force

4.0017, SOUNDING ROCKET SUPPORT
H. LAWRENCE, New Mexico State University, Graduate School, *Las Cruces, New Mexico* 88001 (NAS 5-24241)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

4.0018, TACAN/DME DEVELOPMENT
UNKNOWN, Sierra Research Corporation, *Buffalo, New York* 14225 (FA58611; FA75WA-3634)

Project includes: 1. The study and analysis of specific and general problems involving TACAN/DME system operations; 2. The design and development of TACAN/DME ground and avionics equipments including modifications thereto; and 3. The evaluation and validation of specific equipments and concepts.

SUPPORTED BY U.S. Dept. of Transportation, Office of the Secretary

4.0019, MASS TRANSPORT PHENOMENA BETWEEN BUBBLES AND DISSOLVED GASES IN LIQUIDS IN A ZERO-G ENVIRONMENT
K.J. DEWITT, Univ. of Toledo, School of Engineering, *Toledo, Ohio* 43606 (NSG 3121)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

4.0020, BOUNDARY CONDITION AT A WIND TUNNEL WALL FOR A LIFTING WING BODY COMBINATION AT LOW SUPERSONIC SPEED
G. DROUGGE, Aeronautical Res. Inst., *Bromma, Sweden* (DF048170; AF-AFOSR-3282-77)

AF function - aerospace vehicles, air-breathing propulsion. Deficiency - lack of adequate correction methods for wind tunnel data for lifting configurations at transonic speeds. Objective - to experimentally and, if possible, theoretically determine the wall-boundary conditions for a lifting wing-body model at high transonic speeds. How work contributes - wind tunnels are often mainly used for development testing of aircraft and missiles. While tests have shown that for non-lifting models, the wall interference is far from negligible and that the results can in most cases be considered as acceptable for routine testing very little is known about the required wall characteristics for a lifting aircraft configuration. If the wall criteria resulting from this investigation agree reasonably well with the criteria used for the development of existing tunnel walls, the assumption that these walls are the most suitable for routine testing will be confirmed. If the results disagree new ideas will be generated concerning necessary modifications of existing walls or possible new wall configurations will be proposed.

By measuring the flow about a hypothetical cylindrical surface surrounding a lifting model the boundary conditions at a hypothetical test section wall will be determined. Comparison will be made with the calculated flow around the same wing-body combination using a computer program already available at FFA.

ADDENDA: Supporting agency address is: AF Office of Scientific Research NA, Bldg 410, Bolling AFB, DC 20332

SUPPORTED BY U.S. Dept. of Defense, Air Force

4.0021, A STUDY OF MODULATION AND DATA-TRANSFER TECHNIQUES APPLIED TO SATELLITE DATA COLLECTION
R.W. ROCHELLE, Univ. of Tennessee, School of Engineering, *Knoxville, Tennessee* 37916 (NAS 5-24250)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

4.0022, RADIO PROPAGATION VIA TRANSPONDER
T. TROST, Texas Technological University, School of Engineering, *Lubbock, Texas* 79409 (DF049280; AF-AFOSR-3374-77)

AF function - a uhf transponder will be flown by the AF in a parachute-borne instrument package over southern New Mexico in the summer of 1977. The parachute and instrument package will be launched from the White Sands Missile Range by a NASA rocket. While in flight, the transponder will relay signals transmitted to it from a ground station. It is proposed to design and operate receiving equipment at two distant sites (Lubbock, TX, and Wichita Falls, TX) to receive the transponder signals and determine the signal characteristics as a function of the altitude and horizontal travel of the parachute. This will allow experimental verification of predicted radio propagation effects. Opportunity - the scheduled flight provides an excellent opportunity to carry out theoretical predictions of propagation and test them directly by experiment. Objective - an experimental investigation of the propagation characteristics of radio signals transmitted between two ground stations via a parachute-borne transponder will be conducted. Contribution - the work will involve the calculation of the expected signal strength vs. parachute location, the instrumentation of two radio receiving sites, including the design and construction of custom receiving antennas, and the recording and analysis of the signals received via the transponder.

To have a theoretical basis for evaluating the experimental results, the signal-to-noise ratios to be expected at the receiving sites as a function of parachute location and estimated meteorological conditions will be calculated. Two receiving antennas, one for each site, will be designed and tested; the antenna types to be considered are the helix, corner reflector and YAGI. The radio frequency to be used is 387.2 mHz. The antennas will be connected to receivers with outputs recorded on analog tape. Both the carrier level and the modulation (AM) will be recorded, along with the time of day from WWV transmissions at 10 mHz. The signal strength recordings will then be compared with the calculated signal strengths and differences interpreted in terms of the meteorological variables which affect signal propagation.

ADDENDA: Supporting agency address is: AF Office of Scientific Research NP, Bldg 410, Bolling AFB, DC 20332

SUPPORTED BY U.S. Dept. of Defense, Air Force

GEOSCIENCES

Includes Geosciences (general); Earth Resources; Energy Production and Conversion; Environment Pollution; Geophysics; Meteorology and Climatology; and Oceanography. For Related Information See Also Space Sciences.

5.0001, GLACIOLOGICAL-VOLCANOLOGICAL RESEARCH ON MT. WRANGELL, ALASKA
C.S. BENSON, Univ. of Alaska, School of Earth Sc. & Min. Ind, *Fairbanks, Alaska* 99735 (EAR77-15166)

This project is a continuation of research on the effects of volcanic heat flux from Mt. Wrangell in Alaska on glacier ice on and around the mountain. An increase in volcanic heat flow that became pronounced in 1964 has caused a lowering of ice levels in the summit caldera and changes in the behavior of glaciers in valleys on the mountain flanks. A network of field stations has been set up to measure changes in snow and ice positions, seismicity, and ground temperatures. A data-collection platform and seismic event counter provided by the U.S. Geological Survey allow monitoring of air temperature, seismic events, and soil temperatures through a satellite system. Further work will include ice-depth sounding with airborne radio-echo equipment, collection of further black and white and infrared imagery, studies of stream chemistry, and gravity measurements in the summit area. The research will provide quantitative information on both the heat flow related to the increasing volcanic activity and the effects of the heating on glacier activity.

SUPPORTED BY U.S. National Science Foundation, Div. of Earth Sciences

5.0002, INVESTIGATIONS OF THE RELATIONS OF MICROPULSATIONS TO MAGNETOSPHERIC PLASMA STRUCTURE

R.R. HEACOCK, Univ. of Alaska, Geophysical Institute, *Fairbanks, Alaska* 99701 (ATM77-11469)

This grant will support the University of Alaska pulsation programs and related data analyses for another year. Observational work will be: (1) The induction magnetometer system at College will be operated continuously; (2) Magnetic field pulsations and riometer pulsations will be telemetered from Fort Yukon and recorded at College for selected intervals; (3) College and Poker Flat riometer pulsations will be recorded for selected intervals; (4) The new 2-component induction magnetometer installation at Sachs Harbour will be operated for selected intervals; (5) A data logger will be purchased and installed at the Macquaries Island induction magnetometer site, the data to be recorded under a cooperative arrangement with the Australians; and (6) Geophysical Institute induction magnetometers at Blackburn (near Ottawa) and at various locations in Finland will continue in operation; the Geophysical Institute will furnish supplies to the cooperating groups that operate the equipment.

On the analysis side, computer programs will be written to permit translation of the data recorded in direct mode on the Finland magnetic tapes into digital form with linear amplitude scales. Additional programs will be written for the processing of the Hawkeye I satellite magnetometer data. Wave coupling between the interplanetary medium and the magnetosphere will be studied. Cooperative studies will be pursued with the groups in Finland and Australia, and with the satellite groups at the University of Iowa, University of Minnesota, University of California, Los Angeles, and at the Space Environment Laboratory, Boulder.

SUPPORTED BY U.S. National Science Foundation, Div. of Atmospheric Sciences

5.0003, ANALYSIS OF SAND-SIZE PARTICLES ABRADED UNDER MARTIAN CONDITIONS

D. KRINSLEY, Arizona State University, School of Liberal Arts, *Tempe, Arizona* 85281 (NCA 2-35703)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

5.0004, AIRCRAFT MEASUREMENTS IN SUPPORT OF PROJECT MISTT, MIDWEST INTERSTATE SULFER TRANSFORMATION AND TRANSPORT

UNKNOWN, Meteorology Research Inc., *Altadena, California* 91001 (68-02-2411; G624B-EA-07)

The purpose of the 1976 MISTT study is to extend the results of previous studies to cover larger distances from the sources and obtain more detailed knowledge of the chemical processes occurring in polluted air. The aerosol formation processes as well as gaseous plume chemistry will be the subject of continued study. Conversion rates and mechanisms identified earlier need to be verified under a variety of meteorological conditions. The aerosol chemistry of the urban and power plants plumes will be examined using new techniques which will yield information on substances other than sulfate. In addition to refining our understanding of the chemical processes, the 1976 program will attempt to better define the regional transport and accumulation mechanisms at work in the Eastern United States. The project will be expanded from the immediate St. Louis area to include the study of pollutant accumulation and transport in synoptic scale, slow moving, stable air masses.

SUPPORTED BY U.S. Environmental Protection Agency, Office of Research & Development, Environmental Sciences Research Lab.

5.0005, USER-DRIVEN REMOTE SENSING APPLICATIONS - DYNAMICS OF THE PACIFIC NORTHWEST EXPERIENCE

R.A. COLWELL, Univ. of California, School of Natural Resources, *Berkeley, California* 94720 (NSG 2243)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

5.0006, NAVY ENVIRONMENT - MARINE ATMOSPHERIC AEROSOL

M. GRIGGS, Science Applications Inc., *La Jolla, California* 92037 (DN775510; N00014-77-C-0489)

Determine the atmospheric aerosol optical thickness over the ocean in order to validate a technique which will provide daily global maps of aerosol isopleths over the ocean.

By coordinating ground truth observations (made from the USNS Hayes during her Spring 1977 electro-optical meteorology (EO/MET) research cruise) with measurements made from satellites approximately at the Hayes' zenith, determine the earth's atmospheric aerosols burden by relating the upwelling visible radiance measured by satellite to the aerosol optical thickness of the atmosphere. This technique, based on LANDSAT data, can be expanded to such existing satellites as NOAA, DMSP and GOES.

ADDENDA: Supporting agency address is: Office of Naval Research, Arlington, VA 22217

SUPPORTED BY U.S. Dept. of Defense, Navy

5.0007, PLASMA-LINE STUDIES WITH THE INCOHERENT-SCATTER RADARS AT ARECIBO

V.B. WICKWAR, Stanford Research Institute, *Menlo Park, California* 94025 (ATM76-21305)

This action funds the first year of a two-year continuing grant for studies of the Earth's ionosphere using the incoherent scatter radar facility at the National Astronomy and Ionosphere Center at Arecibo, Puerto Rico. Research to be done falls into two main parts. The first part centers around the analysis of existing data; the second involves new measurements. Included in the first are studies of plasma lines and photoelectron fluxes at Arecibo, and the analysis of data taken during past ionospheric heating experiments there. The second includes development of new data acquisition software for NAIC, new plasma line observations, and participation in future ionospheric heating experiments.

SUPPORTED BY U.S. National Science Foundation, Div. of Atmospheric Sciences

5.0008, USE OF THE CHAPPUIS BAND FOR DETERMINATION OF MODERN AND HISTORICAL STRATOSPHERIC OZONE LEVELS

R.J. ANGIONE, Calif. State Univ. & Colleges, School of Liberal Arts, *San Diego, California* 92115 (NSG 1430)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

5.0009, ARCTIC TROPOSPHERIC AND STRATOSPHERIC WINDS MEASURED BY RADAR TECHNIQUES

B.B. BALSLEY, U.S. Dept. of Commerce, Natl. Oceanic & Atmos. Admin., *Boulder, Colorado* 80302 (ATM77-19756)

This grant funds a developmental and experimental investigation of the dynamics and structure of the Arctic troposphere and stratosphere using the Chatanika incoherent scatter radar. Using newly developed techniques, the radar will obtain wind profiles on a rapid and repetitive basis. Particular areas to be investigated include exchange mechanisms between the troposphere and stratosphere, stratospheric warmings, and turbulence. Successful development and implementation of this technique will give us a powerful new tool for studies of the low and middle atmosphere.

SUPPORTED BY U.S. National Science Foundation, Div. of Atmospheric Sciences

5.0010, GEOPHYSICAL METROLOGY - EARTHQUAKE PREDICTION

P.L. BENDER, U.S. Dept. of Commerce, Natl. Bureau of Standards, *Boulder, Colorado* 80302 (2741163)

PURPOSE: To study and facilitate the use of accurate geophysical distance measurements in seismic zones of the U.S. for earthquake prediction and for understanding earthquake mechanisms, in support of the proposed National Program for Earthquake Disaster Mitigation.

OBJECTIVES: To study distance measurement techniques which can contribute to warning networks for anomalous crustal movements in seismic zones of the U.S.; to study the accuracy/cost trade-offs for measuring movements of the Earth's crust in seismic zones of the U.S.

FY77 MILESTONES: a) Contribute information on feasible new distance measurement techniques for earthquake prediction to NASA Earth Dynamics Advisory Sub-Committee and to draft report of NAS-NRC Committee on Geodesy, September 1977; b) Act as NBS liaison representative for FY/77 to USGS Earthquake Studies Advisory Panel, September 1977.

ACCOMPLISHMENTS: a) Publication with scientists from other institutions of important test of gravitational theory based on lunar ranging results, March 1976; b) Publication with scientists from other institutions of Universal Time determinations with unprecedented accuracy derived from lunar range data, September 1976; c) Carried out discussions with personnel from NASA, NGS, USGS, and August 1976 the SAO ooncerning the possibility of demonstrating cost-effectiveness of new techniques for monitoring crustal movements, August 1976.

SUPPORTED BY U.S. Dept. of Commerce, National Bureau of Standards

5.0011, PARTICIPATION OF NOAA/WPL DUAL-DOPPLER RADARS IN THE 1977 SOUTH PARK AREA CUMULUS EXPERIMENT

E.E. GOSSARD, U.S. Dept. of Commerce, Wave Propagation Laboratory, *Boulder, Colorado* 80302 (ATM77-22115)

The Colorado State University is performing an experiment in the South Park area aimed at cumulogenesis and cloud-mesoscale interaction. This will bring together a sophisticated observation array of radars, aircraft, and other ground-based instruments. NCAR will provide two C-band Doppler radars for the experiment with two X-band Doppler radars to be provided by the Wave Propagation Lab of NOAA. This will provide a continuous triple Doppler system for the duration of the experiment and enables one of the NCAR radars to be transferred to Florida during that period. The Doppler radars will be used with chaff releases to provide information on both cloud scale motions and on smaller turbulence scales.

SUPPORTED BY U.S. National Science Foundation, Div. of Atmospheric Sciences

5.0012, SPECIAL TRAVEL FUNDS FOR SCIENTISTS PARTICIPATING IN THE PROPOSED AERIAL STUDY OF THE SOMALI JET STREAM DURING MONSOON 77, MAY-JUNE 1977

J.E. HART, Univ. of Colorado, School of Arts & Sciences, *Boulder, Colorado* 80302 (ATM76-81097)

The objective of this research is to obtain aircraft measurements of meteorological quantities associated with the southerly low-level jet along the Kenyan Coast, known as the Somali or East African jet. These measurements and their analysis will serve as a prelude to the planning and execution of field operations during the First GARP Global Experiment (FGGE) and the Monsoon Experiment (MONEX), both to be carried out in FY 79.

The period of observations coincides with a major Soviet scientific expedition MONEX 77, thus ensuring the availability of additional ship data for thorough analyses and comprehension of the aircraft data.

The measurements will be made from the National Center for Atmospheric Research's (NCAR) Electra aircraft.

SUPPORTED BY U.S. National Science Foundation, Div. of Atmospheric Sciences

5.0013, MISCELLANEOUS LANDSLIDE INVESTIGATIONS

R.W. FLEMING, U.S. Dept. of The Interior, Geological Survey, *Denver, Colorado* 80225 (9550-01632)

STATES TO WHICH PROJECT PERTAINS: Nationwide project.

Miscellaneous Landslide Investigations have a primary objective of reduction of the hazard caused by landslides. The program for Landslide Hazard Reduction has been funded as an informal activity of the Office of Environmental Geology for FY 77. Coordination of landslide projects in the USGS and compilation of information on landslides will be performed in this project for the Landslide Hazard Reduction Program. Also, studies will be continued of costs of landsliding, mechanics of the landslide movemnt in Manti Canyon, Utah, development of high-resolution remote sensing techniques for slope stability studies, measurements of displacements at Clear Creek Forks and Slumgullion, Colorado, and mechanics of rockfall.

SUPPORTED BY U.S. Dept. of the Interior, Geological Survey, Geologic Div.

5.0014, TUNNEL DETECTION

F. FRISCHKNECHT, U.S. Dept. of The Interior, Geological Survey, *Denver, Colorado* 80225 (9780-01809)

The objective is to assess the effectiveness of the airborne INPUT electromagnetic system in locating underground workings which contain well-grounded metallic conductors. Methods of study include numerical and physical scale modelling, study of existing INPUT data over cultural features and actual field tests using an INPUT system.

SUPPORTED BY U.S. Dept. of the Interior, Geological Survey, Geologic Div.

5.0015, INFRARED INVESTIGATIONS OF GEOLOGIC MATERIALS

H.A. POHN, U.S. Dept. of The Interior, Geological Survey, *Denver, Colorado* 80225 (9790-01701)

Continued studies are planned into the distribution of copper deposits in Western Asia through the analysis of computer-enhanced LANDSAT images.

Future plans also include the laboratory spectral analysis in the visible and near infrared of whole rock specimens and natural surface contaminates for the selection of optimum spectral bands for discriminating lithologic units.

SUPPORTED BY U.S. Dept. of the Interior, Geological Survey, Geologic Div.

5.0016, STRATOSPHERIC AEROSOL AND GAS EXPERIMENT

D.G. MURCRAY, Univ. of Denver, School of Arts & Sciences, *Denver, Colorado* 80210 (NAS 1-14929)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

5.0017, GROUND MONITORING OF ATMOSPHERIC CONSTITUENTS BY HIGH-RESOLUTION INFRARED SOLAR SPECTROSCOPY

D.G. MURCRAY, Univ. of Denver, School of Arts & Sciences, *Denver, Colorado* 80210 (NSG 1432)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

5.0018, AN ATTEMPT TO MEASURE STRATOSPHERIC CONSTITUENTS BY MEANS OF SOLAR OCCULTATION MEASUREMENTS

D.G. MURCRAY, Univ. of Denver, School of Arts & Sciences, *Denver, Colorado* 80210 (NSG 1439)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

5.0019, MEASUREMENTS OF STRATOSPHERIC DISTRIBUTION OF SEVERAL CONSTITUENTS OF INTEREST IN PHOTOCHEMISTRY OF THE OZONE LAYER AS PART OF STRATCOM VIII

D.G. MURCRAY, Univ. of Denver, School of Arts & Sciences, *Denver, Colorado* 80210 (NSG 7354)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

5.0020, APPLICATION OF REMOTE SENSING (LANDSAT) DATA TO COLORADO'S AGRICULTURAL REGIONS

E.L. MAXWELL, Colorado State University, School of For. & Natural Res., *Fort Collins, Colorado* 80523 (0072002; COL00150)

OBJECTIVE: Determine the extent to which land use and vegetation can be inventoried using LANDSAT imagery. Investigate specific agricultural applications in cooperation with the Colorado Department of Agriculture.

APPROACH: Seven and one-half minute quadrangles in Eastern Colorado or in the San Luis Valley will be selected for mapping. Existing LANDSAT imagery (from other projects) will be used unless county or state agencies purchase imagery for special applications. County agents, state foresters or Departmemt of Agriculture personnel will provide ground truth for selected areas. Specific problems such as weed infestations will be investigated if time and money permit.

SUPPORTED BY U.S. Dept. of Agriculture, Cooperative State Research Service, Colorado

5.0021, SCIENCE SUPPORT FOR THE STRATOSPHERIC AEROSOL AND GAS EXPERIMENT

R.A. CRAIG, State University of Fla. Sys., School of Arts & Sciences, *Tallahassee, Florida* 32306 (NAS 1-14930)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

5.0022, COORDINATED OBSERVATIONS OF LOWER THERMOSPHERICAL CIRCULATION

R.G. ROPER, Georgia Inst. of Technology, School of Aerospace Engin., *Atlanta, Georgia* 30332 (ATM76-81558)

This grant funds coordinated observations of lower thermospheric circulation being carried out by a global network of meteor wind facilities and incoherent scatter radars. It also funds the collation, interpretation and publication of the results as they pertain to global neutral atmosphere motions in the height range 80 to 120 kilometers, with due regard being given to interaction with the lower and higher atmosphere.

SUPPORTED BY U.S. National Science Foundation, Div. of Atmospheric Sciences

5.0023, SYNOPTIC ANALYSIS FOR THE GLOBAL ATMOSPHERIC RESEARCH PROGRAM (GARP) ATLANTIC TROPICAL EXPERIMENT (GATE)

J.C. SADLER, Univ. of Hawaii, School of Arts & Sciences, *Honolulu, Hawaii* 96822 (ATM72-01680 A04)

The objective of this project continues to be the preparation of analyzed charts of meteorological conditions over the tropics during the Global Atmospheric Research Program (GARP) Atlantic Tropical Experiment (GATE). This phase of the work involves the completion of the data collection effort to be followed by the subjective (hand) analyses of daily charts of winds, temperature, pressure heights and moisture over the GATE region. These charts will be compared with mean monthly analyses (already completed under this grant) in order to evaluate the representativeness of the GATE period. In addition, the daily charts will be used to test indirect methods of obtaining meteorological fields, such as wind vectors derived from satellite cloud fields.

SUPPORTED BY U.S. National Science Foundation, Div. of Atmospheric Sciences

5.0024, EVALUATION OF A PROPOSED RESEARCH NATURAL AREA OF LARUE-PINE HILLS SHAWNEE NATIONAL FOREST

G.T. WEAVER, Southern Illinois University, School of Agriculture, *Carbondale, Illinois* 62901 (0069890; ILLZ-75-R-022)

OBJECTIVE: Determine the suitability for research natural area (RNA) designation of an area adjacent to the LaRue-Pine Hills Ecological Area in the Shawnee National Forest; test the use of indirect ordination techniques in mapping vegetation; prepare a management plan for the area if it is suitable for RNA designation.

APPROACH: The natural features of the area will be inventoried using Kuchler's comprehensive method which is based on identification of contrasting areas on aerial photographs and their description from field work. Indirect ordination techniques will be used to classify sampling areas and produce a final map of natural features.

SUPPORTED BY Illinois State Government

5.0025, BALLOON-BORNE SPECTROSCOPY OF STRATOSPHERIC CONSTITUENTS

L.D. KAPLAN, Univ. of Chicago, School of Physical Sciences, *Chicago, Illinois* 60637 (NSG 7356)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

5.0026, SATELLITE ACCELEROMETER DENSITY MEASUREMENTS

F.A. MARCOS, U.S. Air Force, Geophysics Laboratory, *Bedford, Massachusetts* 01730 (DF249450)

AF function - airborne surveillance, target acquisition. Deficiency - atmospheric density variations with time and space cannot be accurately predicted. Objective - direct density measurements with satellite-borne accelerometers. Low satellite altitude measurements are emphasized. Results are correlated with solar-geophysical parameters and other experiments. How research contributes - in-flight accelerometer drag measurements permit accurate determination of Air Force satellite ephemerides. Development of more accurate models allows more accurate prediction of satellite motion improving orbit vehicle surveillance capability.

Three flights of the new SETA accelerometer are scheduled during CY77 on AF/DMA satellites. SETA is a new instrument utilizing single proof mass measure accelerations along three orthogonal axes. The instrument will be used to measure density, winds and spacecraft attitude. Acquisition and reduction of data from the AE-C, AE-E and S3-2 accelerometers will continue along with reduction of data from the decayed AE-D and S3-1 satellites. Density results from these and other accelerometer flights will be incorporated into a unified data base along with correlative data. This will permit comprehensive analyses and development of models emphasizing dynamic aspects of the lower thermosphere. A single-axis accelerometer mounted on a rotatable table will be flown on the S77-2 spacecraft. This instrument provides the capability of removing inherent bias errors which cannot be separated from drag effects in a circular orbit.

ADDENDA: Supporting agency address is: AF Geophysics Laboratory LK Hanscom AFB, Bedford, Mass 01730

SUPPORTED BY U.S. Dept. of Defense, Air Force

5.0027, LARGE-SCALE OPTICAL MAPPING OF THE IONOSPHERE

E.J. WEBER, U.S. Air Force, Geophysics Laboratory, *Bedford, Massachusetts* 01730 (DF249790)

AF function - communications and detection. Deficiency - understanding effects of both precipitating particle and non-particle produced ionospheric disturbances on communications at high and equatorial magnetic latitudes. Objective - investigate ionospheric disturbance phenomena by observation of auroral emission features measured with a sensitive imaging system. How research contributes - the disturbed ionospheric environment affects AF ground, airborne and satellite communications and radar

systems. The contribution is a better understanding of dynamic ionospheric-magnetospheric processes through measurement and analysis of associated optical emissions, and better specification of ionospheric disturbances to communication satellite SPO's and DMSP, especially during times of coordinated test programs.

High-time-resolution measurements of auroral optical emissions, with large spatial coverage, will be coordinated with other simultaneous geophysical measurements from the AFCRL Airborne Ionospheric Observatory, NKC-135 aircraft no. 53131, and from selected ground stations and satellites to provide a means of assessing ionospheric response to magnetospheric substorms over sub-auroral, auroral and polar cap regions. Characteristics of precipitation particles will be derived from the optical measurements and these, together with ionosonde measurements, will be used to study the behavior of the ionospheric e and f regions. Disturbance phenomena such as sudden auroral activations or irregular structures will be well documented to allow direct comparison of the effect of these features on AF systems.

ADDENDA: Supporting agency address is: AF Geophysics Laboratory PH Hanscom AFB, Bedford, Mass 01730

SUPPORTED BY U.S. Dept. of Defense, Air Force

5.0028, MERIDIAN PHOTOMETER CHAIN

R.H. EATHER, Boston College, School of Arts & Sciences, *Chestnut Hill, Massachusetts* 02167 (ATM77-04286)

This grant funds the fielding, operation, and data analysis of a three-station meridian-scanning photometer chain along the Canadian auroral oval. Scientific objectives of the program include the investigation of subvisual pre-substorm signatures in spectral and spatial characteristics of the aurora, the details of spectral changes during poleward expansion and recovery, the role of protons in the substorm process, the nature of the diffuse aurora, and the integrated conductivity of the auroral region during substorm process. In coordination with satellites such as ISIS-II, TRIAD, and ISEE there is planned an investigation of field-aligned currents, the nature of near-Earth acceleration mechanisms, and their relationship to the latitude-time morphology of precipitation.

SUPPORTED BY U.S. National Science Foundation, Div. of Atmospheric Sciences

5.0029, A STUDY OF ATMOSPHERIC TRANSMITTANCE IN THE INFRARED FOR SATELLITE TEMPERATURE SOUNDING

B. KIVEL, Avco Corporation, *Everett, Massachusetts* 02149 (9-132; 7-35253)

OBJECTIVE: To determine the physical properties which help to accurately define the spectral absorption characteristics of atmospheric gases as applied to the 15 micromillimeters atmospheric band utilized in temperature determinations from satellite measurements. Current knowledge is not sufficient to determine the temperatures based solely on physical radiative transfer considerations.

APPROACH: The physical processes which determine atmospheric transmittance at 15 micromillimeters will be reviewed in order to identify major uncertainties in existing knowledge. Special emphasis will be placed on the physics of the widths and shapes of CO2 and H2O spectral lines and on the H2O continuum in the thermal infrared. These studies will be applied to the problems of developing atmospheric transmittance models suitable for determining atmospheric temperatures.

PROGRESS: The most significant result to date shows that an increase of about 30% in accepted value of CO2 line width at 700 cm to the minus first power gives better agreement for temperature determinations as deduced from satellite data. Additional studies using a physical model of the atmosphere emphasize the need for obtaining more accurate values for the absorption coefficient of the water vapor continuum and for the pressure-broadened widths of H2O lines in the region from 400-550 cm to the minus first power.

SUPPORTED BY U.S. Dept. of Commerce, National Oceanic & Atmospheric Admin., National Environmental Satellite Service

5.0030, INCOHERENT-SCATTER STUDIES AT MILLSTONE HILL DURING THE INTERNATIONAL MAGNETOSPHERE STUDY 1976-79

J.V. EVANS, Mass. Inst. of Technology, Lincoln Laboratory, *Lexington, Massachusetts* 02173 (ATM75-22193 A01)

This grant funds the operation of the Millstone Hill incoherent-scatter radar facility to conduct measurements and analyses of physical parameters of the upper atmosphere and ionosphere. Particular investigations being pursued include: 1. detailed measurements of the temperature and wind structure in the lower thermosphere, to better understand tidal effects and temporal variations there; 2. work with NASA combining the Millstone Hill data with NASA satellite data to develop a more accurate model of the atmosphere above 100 km; and 3. studies of dynamical processes in the atmosphere, including neutral winds, plasma diffusion along magnetic field lines, electric fields, and magnetic storms.

SUPPORTED BY U.S. National Science Foundation, Div. of Atmospheric Sciences

5.0031, MEASUREMENTS OF ELECTRICAL CONDITIONS IN THUNDERCLOUDS

C.B. MOORE, New Mexico Inst. Min. & Tech., Graduate School, *Socorro, New Mexico* 87801 (ATM74-13304 A02)

The problems of how thunderclouds become electrified and the relation between cloud electrification and the formation of precipitation are still unsolved. This situation results in part because it is difficult to infer electrical properties inside thunderclouds from measurements at the earth's surface. Recent measurements from instrumented free balloons show quite different behaviors of the electric field aloft and of the charge carried by precipitation than have been predicted.

This research will continue field and theoretical investigations of thunderclouds using improved balloon instrumentation and a low-speed airplane equipped with electric field meters and space charge measuring equipment. The work will be part of the Thunderstorm Research Program in Florida at the Kennedy Space Center and over Langmuir Laboratory in New Mexico. The initiation of this basic research program at Kennedy Space Center has been stimulated in part by the problems lightning caused during the Apollo series and potential related questions for the space shuttle.

SUPPORTED BY U.S. National Science Foundation, Div. of Atmospheric Sciences

5.0032, ATMOSPHERIC HIGH-ENERGY NEUTRONS

G.M. FRYE, Case Western Reserve Univ., Graduate School, *Cleveland, Ohio* 44106 (ATM76-11637 A02)

This grant will support the analysis of data obtained during a balloon flight from Broken Hill, Australia, on April 15, 1977, with the EOSCOR (Extended Observation of Solar and Cosmic Radiation) detector. This experiment was developed by a Case Western Reserve University and Melbourne University collaboration for the long-duration balloon flight system under development by NCAR and therefore meets its constraints on total weight, power, and telemetry. The basic design philosophy of the EOSCOR detector was to combine an effective detecting area of two square meters with reasonable detection efficiency and good time resolution to separate neutrons and gamma-rays.

The balloon flight from Broken Hill reached an altitude of 50 k ft (approximately 100 mbar) when the balloon burst. Recovery of the experiment was carried out with no damage to the scientific package. Since the downward atmospheric neutron flux is near maximum at 100 mbar, further analysis should indicate the sensitivity of the instrument to neutron events in the atmospheric radiation environment. The investigators have already tested the neutron detection efficiency at the CWRU Van de Graaff accelerator. The intention of this grant is to establish background counting rates for the detector so that a better estimate of sensitivity to solar neutrons at the top of the atmosphere can be made.

SUPPORTED BY U.S. National Science Foundation, Div. of Atmospheric Sciences

5.0033, INFRARED SPECTROSCOPY FOR ATMOSPHERIC CHEMISTRY
K.N. RAO, Ohio State University, School of Math. & Phys. Scis., *Columbus, Ohio* 43210 (ATM76-08706 A01)

The main objective of this program of research is the pursuit of quantitative spectroscopy in the infrared relevant to studies of the earth's atmosphere. The investigations will be carried out using two precision vacuum infrared spectrographs both equipped with the largest Harrison-ruled 16' x 8' echelles. The groove spacings of these two gratings are such that experimental work can be conducted in the near infrared between 1 and 25 microns. Efforts continue to modernize the technology available in the laboratory. One aspect of this modernization is related to the development of a very high resolving power Fourier transform spectrometer. The types of investigations undertaken in the laboratory can best be pursued by using both these techniques--gratings and Fourier--as appropriate.

SUPPORTED BY U.S. National Science Foundation, Div. of Atmospheric Sciences

5.0034, ELECTROMAGNETIC SCATTERING PROPERTIES OF HYDROMETEORS AND THEIR APPLICATION TO RADAR METEOROLOGY
T.A. SELIGA, Ohio State University, School of Engineering, *Columbus, Ohio* 43212 (ATM76-83468)

The free-fall behavior and shape of hydrometeors are known to produce important differences in their differential scattering characteristics. This proposal requests support to continue and extend much of the work initiated by the principal investigator in this area. The main objectives are to (1) calculate the differential scattering properties of hydrometeors of varying size and shape, including water-coated hail; (2) extend Waterman's extended boundary condition technique for calculating radar cross sections to irregularly shaped three-dimensional bodies; (3) interpret the radar cross-section calculations and search for radar signatures which may be useful in identifying and quantifying precipitation; and (4) perform basic experiments to test differential reflectivity as a radar parameter which may provide important information on precipitation types and rainfall rates.

SUPPORTED BY U.S. National Science Foundation, Div. of Atmospheric Sciences

5.0035, ORIGIN AND LIFE CYCLE OF TORNADO CYCLONES
J. MCCARTHY, Univ. of Oklahoma, School of Arts & Sciences, *Norman, Oklahoma* 73069 (ATM74-03400 A03)

This research will study the origin and life cycle of tornado cyclones in Oklahoma and observed by the National Severe Storms Laboratory and the University of Chicago and University of Illinois (NSSL/CHILL) triple Doppler radar system, using a chaff distributing aircraft. A complementary study is proposed by the University of Wyoming to obtain physical and dynamical measurements of the environment of the storms using an instrumented airplane. It will continue tornado life-cycle analyses with data obtained under a predecessor grant (NSF GA-41844). These included the life cycle of two tornado cyclones occurring in 1974 using the Wyoming Queen Air, chaff dispersal, and the NSSL dual Doppler Radar System. In one case (8 June 74, Harrah storm) a tornado was observed to occur. The new field program with NSSL and Wyoming is aimed at further understanding of the genesis mechanisms and evolution of tornado cyclones. Two one-month field efforts are planned during 1976 and 1977, respectively.

SUPPORTED BY U.S. National Science Foundation, Div. of Atmospheric Sciences

5.0036, FAR-INFRARED MEASUREMENTS OF TRACE CONSTITUENTS
I.G. NOLT, Oregon State Higher Educ. Sys., School of Liberal Arts, *Eugene, Oregon* 97401 (NSG 7360)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

5.0037, FOREIGN CURRENCY AWARD FOR DIGITAL PROCESSING OF MULTISPECTRAL SCANNER FOR GEOLOGIC INFORMATION IN THE CHAGAI, PAKISTAN (ABBREV)
S.A. BILGRAMI, Resource Development Corp., *Karachi, Pakistan* (INT77-07767)

Through a cooperative project, scientists from Resource Development Corporation and Dartmouth College will study and refine the methods of computer classification of satellite scanner data. They will apply these methods in the geological studies of areas of copper deposit potential in the Chagai Hills region of Pakistan. The relationship between the geological properties of any mineral deposits found in the region and the characteristics of the satellite scanner data will be investigated.

SUPPORTED BY U.S. National Science Foundation, Div. of International Programs

5.0038, AIRGLOW AND AURORAL STUDIES OF THE EARTH'S IONOSPHERE
M.A. BIONDI, Univ. of Pittsburgh, School of Arts & Sciences, *Pittsburgh, Pennsylvania* 15260 (ATM77-17525)

This grant funds a continued experimental program of ground-based observations of the twilight and nightglow emissions from the earth's upper atmosphere. Two main observational techniques are employed: (1) large aperture, pressure scanned Fabry-Perot (FP) interferometers measure twilight and nightglow spectral line profiles to determine neutral temperatures and excitation mechanisms (from line widths) and neutral wind vectors (from Doppler shifts in line positions) and (2) spatial scanning, filter photometers map nightglow emissions from the normal and artifically perturbed ionosphere (Ionospheric Modification Experiments, I.M.E.). Principal observation sites will continue to be Laurel Ridge, Pa., Airglow Observatory (LRO) at 40 degrees 8' N and 79 degrees 10' W and Arecibo Observatory, Puerto Rico, (AO) at 18 degrees 21' N and 66 degrees 45' W.

SUPPORTED BY U.S. National Science Foundation, Div. of Atmospheric Sciences

5.0039, SAUDI ARABIAN INVESTIGATIONS - GEOLOGIC MAPPING
F.S. SIMONS, U.S. Dept. of The Interior, Geological Survey, *Riyadh, Saudi Arabia* (9390-62002B)

PLACE TO WHICH PROJECT PERTAINS: Saudi Arabia (western half).

In 1977 the project will map at least three whole and partial 30 minute quandrangles in the southern Arabian Shield. In addition the following special studies will continue through the year: (1) a compilation study of the southern Shield which will include a map at a 1:1,000,000 scale, (2) mineral exploration and petrogenesis of the acid plutonic rocks of the whole Shield, and (3) a detailed study, involving detailed mapping and geophysics, of a Tertiary dike swarm and associated layered intrusions and granites marginal to the Red Sea near Jizan. The first two projects listed above as well as several others will utilize various types of LANDSAT imagery for geologic mapping. A plate tectonic model involving two oceanic plates has been proposed to explain the evolution of the late Proterozoic Arabian Shield; this model will continue to be tested.

SUPPORTED BY U.S. Dept. of the Interior, Geological Survey, Geologic Div.

5.0040, INTERNATIONAL SOUTHERN OCEAN STUDIES (ISOS) - SOUTHERN OCEANS LAGRANGIAN OBSERVATIONS
A.D. KIRWAN, Texas A & M University System, School of Geosciences, *College Station, Texas* 77843 (OCE77-16825)

International Southern Ocean Studies (ISOS) is a multi-institutional and international program which is focused on understanding the dynamics of the Antarctic Circumpolar Current. This project is an important part of ISOS and provides for a study of the survivability of satellite-interrogated surface buoys and the efficiency of their drogues.

An in-situ study of buoy-drogue dynamics will be carried out in Massachusetts Bay. Two types of buoy hulls, a spar and a spar with an inverted cone flotation collar, and two types of drogues, a windowshade and a parachute, will be studied with emphasis on the overall survivability of the drogue and buoy. The results of this study will be used to choose a drogue for five spar buoys. These five spar buoys and drogues will be launched in the Circumpolar Current south of New Zealand during the austral summer, 1977-78. This buoy deployment will not only result in data on the survivability of buoys and drogues in the Southern Ocean, but will also provide information on the scales of ocean currents, sea surface temperatures, and sea-level barometric pressures of the Circumpolar Current. If this pilot deployment is successful, an expanded project would be proposed to study the Circumpolar Current between New Zealand and South America in 1979.

SUPPORTED BY U.S. National Science Foundation, Div. of Ocean Sciences

5.0041, TEMPORAL CORRELATIONS OF ANTECEDENT PRECIPITATION WITH NIMBUS-5 ELECTRICALLY SCANNING MICROWAVE RADIOMETER BRIGHTNESS TEMPERATURES
M.J. MCFARLAND, Texas A & M University System, School of Agriculture, *College Station, Texas* 77843 (NSG 5193)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

5.0042, INTERPRETATION AND EVALUATION OF EXPERIMENTAL DATA RELATED TO REMOTE SENSING OF OCEAN-DUMPED SEWAGE SLUDGE
C.Y. KUO, Old Dominion University, School of Engineering, *Norfolk, Virginia* 23508 (NSG 1441)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

5.0043, VIET NAM DEFOLIATION STUDIES
J.S. BETHEL, Univ. of Washington, School of For. Resources, *Seattle, Washington* 98195 (0062538; WNZ-61-9417)

OBJECTIVE: Determine effects of herbicide spraying on tropical forests of Vietnam and collect data on herbicide sprayed forests for future analysis and use as pertains to tree mortality, growth loss, extent of wood damage and estimates of growth rate since defoliation rings.

APPROACH: Data bank will be established on computer tape through study of 1949, 1958 and 1969-70 aereal photos of Vietnam forests to provide matching pre and post spraying comparisons. Because of security problem matching forested areas in South Vietnam, Thailand, Sabah and Philippine Islands will serve as initial comparison areas. As security improves sample photo will be established in Vietnam for on-the-ground data gathering. Field crews will be used in the surrounding countries to make ground truth studies which will be moved to Vietnam as the situation permits.

SUPPORTED BY Washington State Government

5.0044, COMPLETION OF THE GEOPHYSICAL SURVEY OF THE ROSS ICE SHELF
C.R. BENTLEY, Univ. of Wisconsin, School of Letters & Science, *Madison, Wisconsin* 53706 (DPP76-01415)

By the end of the 1976-77 austral summer field season, three-fourths of the Ross Ice Shelf will have been covered by geophysical survey. It is proposed to complete the coverage during the 1977-78 season. Measurements include determinations of ice thickness, water depth, and gravity at all intersections on a 55-km square grid system, radio-echo profiling from the air closely tied to fixed surface points, several profiles to determine seismic and electromagnetic wave propagation speed through the shelf, one or two long seismic refraction profiles to study upper crustal structure, one or two electrical resistivity profiles, and electromagnetic wave polarization studies.

SUPPORTED BY U.S. National Science Foundation, Div. of Polar Programs

5.0045, REMOTE ELECTROMAGNETIC SENSING OF UNDERGROUND COAL BURNS
E.A. QUINCY, Univ. of Wyoming, School of Engineering, *Laramie, Wyoming* 82070 (E(49-18)-24 14)

The main objective of this research project is to develop and field test an induction system and estimator algorithm for remote determination (at the surface) of the location, shape and size of underground coal burn voids.

Field measurements were conducted with a wideband loop-loop induction system at the Hanna Underground Coal Gasification Site of the LERC during July, August and October of 1976. Soundings were made on traverses at 5 locations. Field data were processed on the new Fourier Analyzer System and 3-dimensional response maps were plotted via the central computing system in both time and frequency domains. Strong anomalies at 5 kHz were observed on traverses over both burns at Hanna II.

Computer programs for generation of induction responses of 3 different buried conducting bodies have been written and tested. The effects of conducting wells and the air-earth interface were explored. Additional information from core samples is required to more accurately model these burn sites such that field measurements can be correlated with models.

A Bayes statistical estimation procedure was developed to interpret induction responses for shape and size information. An analytic and a numerical minimum mean-square-error algorithm were developed for the estimation of the radius of a cylindrical conductor. Performance of the general numerical algorithm was shown to be nearly identical to that of the analytic algorithm.

SUPPORTED BY U.S. Energy Research & Development Admin., Div. of Fossil Energy Research

LIFE SCIENCES

Includes Life Sciences (general); Aerospace Medicine; Behavioral Sciences; Man/system Technology and Life Support; and Planetary Biology.

6.0001, AERONAUTICAL TECHNOLOGY, TECHNICAL AREA M - AVIATION HUMAN ENGINEERING
I.C. STATLER, U.S. Natl. Aero. & Space Adm., Ames Research Center, *Moffett Field, California* 94035 (DA0E3520)

Improve Army air mobility systems by providing improved knowledge, criteria and technology for man-machine integration and by providing better engineering methods for performing the AVSCOM man-machine integration functions.

Systematic exploratory R&D in human performance technology, flight simulation methods and requirements, control and display technology, and man-machine dynamics. The approach emphasizes analytical and experimental studies using laboratory, simulation, mathematical modeling and flight test facilities. These activities have been coordinated with and will complement and support the handling qualities R&D of technical area A and the flight simulator development of technical area K. Objectives will be achieved largely through joint participation with NASA, making maximum use of the facilities and expertise available within NASA for man-machine systems research.

ADDENDA: Supporting agency address is: AVRADCOM Air Mobility R&D Lab, Ames Dir, Ames Rsch Ctr, Moffett Field CA 94035

SUPPORTED BY U.S. Dept. of Defense, Army

6.0002, CENTRAL AND PERIPHERAL MECHANISMS OF TEMPERATURE REGULATION
P.N. DELISCU, Univ. of Santa Clara, School of Science, *Santa Clara, California* 95053 (NCA 2-685714)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

6.0003, DEFINITION OF SPACELAB 1 EXPERIMENT ON EFFECTS OF PROLONGED WEIGHTLESSNESS ON THE HUMORAL RESPONSE IN HUMANS
E.W. VOSS, Univ. of Illinois, School of Liberal Arts & Sci., *Urbana, Illinois* 61801 (NAS 9-15328)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

6.0004, MALE/FEMALE DIFFERENCES IN FLYING SKILL ACQUISITION, FLIGHT SAFETY AND ACCIDENT PRONENESS, AND MOTIVATION FOR FLYING
J. ZVARA, Aerospace Systems Incorporated, *Burlington, Massachusetts* 01803 (DF232860; F33615-77-C-0028)

To investigate civilian male/female differences in flying skill acquisition, flight performance and safety, and motivation for an interest in flying.

A threefold approach will be utilized. First, a review of civilian aircraft accident data will be undertaken with an emphasis on determining if either sex appears disposed towards a greater incidence or type of accidents. Second, a field survey will be administered to a sample of 750 FAA flight instructors, and third, a field survey will be administered to samples of 750 male and 750 female FAA pilots. The emphasis of the field survey will be to determine the existence and possible impact of sex difference.

MILESTONES: Stage I - Review of literature, 1.5 months; Stage II -preparation and approval of survey instruments, 3.0 months; Stage III -investigation of accident data (partly concurrent with Stage II), 1.5 months; Stage IV - survey administration, 2.5 months; Stage V -Analysis, 2.5 months; Stage VI - preparation of final technical report, 3.0 months.

ADDENDA: Supporting agency address is: AF Human Resources Laboratory PEM, Lackland AFB, Texas 78236

SUPPORTED BY U.S. Dept. of Defense, Air Force

6.0005, PROCEDURE TO PREDICT AIRCRAFT NOISE IN COMMUNITIES
D.E. BISHOP, Bolt Beranek & Newman Inc., *Cambridge, Massachusetts* 02138 (DF320240; F33615-77-C-0528)

Noisemap is a fully computerized procedure for predicting the noise exposure produced by the multiplicity of aircraft flight and ground runup operations at an air base. Noisemap is the methodology officially used by the air staff for preparing/assessing environmental noise impact and conducting compatible land-use planning studies. The objective of this research is to ensure noisemap remains the state-of-the-art tool for predicting noise exposure about air installations.

The contractor will conduct detailed analytical studies and development work to refine and update the community-aircraft noise exposure (Noisemap) predictive model. Areas of investigation include improving the overall operating efficiency, application guidelines, and excess ground attenuation models. The contractor will determine the feasibility of expanding Noisefile and Noisemap to include helicopter operations. The contractor will develop a detailed test protocol for improving the current model used for excess sound attenuation. Studies will be made to determine the practical engineering and economical problems inherent in developing and applying demographic and compatible land-use overlays with noisemap as indices of relative environmental noise impact.

ADDENDA: Supporting agency address is: 6570 Aerospace Medical Rsch Lab BB, Wright-Patterson AFB, Ohio 45433

SUPPORTED BY U.S. Dept. of Defense, Air Force

6.0006, STUDY OF PHYSIOLOGICAL EFFECTS OF HEAD COOLING SYSTEM
V. IACONO, U.S. Army, Natick Research & Dev. Command, *Natick, Massachusetts* 01760 (DA0G4408)

To provide an individual cooling system for combat vehicle crewman, helicopter pilots, operators of heavy equipment (combat engineers) and special mission personnel requiring protective clothing. This system will alleviate those personnel working in hot environments from the hazard of heat stress. This work unit will focus on the physiological effects of the system on the soldier.

The individual conditioning system will consist of a thin, flexible cooling liner to be used in conjunction with combat helmets. The liner or liquid transport caps will contain a channeled manifold for circulating a cooled fluid around the head and neck areas. The source of cooling medium will be supplied from a portable modular unit which will contain optional modes for providing temperature regulation of the cooling fluid. This device will utilize semiconductor material to generate electric power and the Electrolux-Servel absorption process for refrigeration.

ADDENDA: Supporting agency address is: Naradcom Natick R&D Command, ATTN- DRXNM-VCA, Natick MA 01760

SUPPORTED BY U.S. Dept. of Defense, Army

6.0007, ASSESSMENT OF PANCREATIC CELLS
C.J. VANOSS, State University of New York, School of Medicine, *Buffalo, New York* 14214 (NAS 9-15365)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

6.0008, MECHANISM OF THIGMOMORPHOGENESIS IN PLANTS WITH REFERENCE TO ROLE OF ETHYLENE AND ITS SIGNIFICANCE TO RESEARCH WITH PLANTS IN SPACE (ABBREV)
M.J. JAFFE, Ohio University, School of Arts & Sciences, *Athens, Ohio* 45701 (NSG 7352)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

6.0009, EXPERIMENTATION IN ROLL AXIS WASHOUT EFFECTS
A.M. JUNKER, U.S. Air Force, Aerospace Medical Res. Lab., *Dayton, Ohio* 45433 (DF317870)

The objective of this work unit is to perform experiments on the roll axis tracking simulator (RATS) using various washout schemes and collect human performance data which will be used for modeling purposes under work unit 6893-02-25.

Under work unit 68930225, System Technology, Inc., will suggest to AMRL/EMT motion washout schemes worth investigating. These schemes will be implemented on the RATS and human operator tracking data will be collected for the different washout techniques employed. Preliminary analysis (spectrum and describing functions) will be performed by AMRL/EMT and the results will be supplied to STI for modeling of the effects of washout on human operator parameters.

ADDENDA: Supporting agency address is: 6570 Aerospace Medical Rsch Lab EM, Wright-Patterson AFB, Ohio 45433

SUPPORTED BY U.S. Dept. of Defense, Air Force

6.0010, MODELING OF HUMAN RESPONSE TO AERODYNAMIC FORCE
I. KALEPS, U.S. Air Force, Aerospace Medical Res. Lab., *Dayton, Ohio* 45433 (DF322950)

Exposure to a high-speed wind stream during ejection from an aircraft poses a serious threat to the safety of the ejectee. Methods are needed for assessing the extent of this hazard under various flight conditions and for different ejection modes and systems. This program seeks to provide an analytic methodology for predicting human body response to wind forces encountered during ejection from aircraft. It will deal with both experimentally and theoretically specified aerodynamic environments in providing body response predictions.

The main modeling emphasis will be placed on the development and refinement of the articulated total body (ATB) model and the preparation both from separate experimental programs and by theoretical means of quantitative specification of the aerodynamic environment surrounding the human body during ejection. The model will be applied to predict body limb motion

resulting from the prescribed aerodynamic environments. It will also provide predictions of stresses and torques within the major long-bone joints and estimates of probable injury resulting from limb excursions outside of normal ranges of motion.

ADDENDA: Supporting agency address is: 6570 Aerospace Medical Rsch Lab BB, Wright-Patterson AFB, Ohio 45433

SUPPORTED BY U.S. Dept. of Defense, Air Force

6.0011, TARGET ACQUISITION PREDICTION

W.N. KAMA, U.S. Air Force, Aerospace Medical Res. Lab., *Dayton, Ohio* 45433 (DF321210)

The purpose of this effort is to apply the methodology, data representation techniques and combinatorial rules/models/algorithms developed under other efforts to systematically portray the combined effects of advanced sensors, control/display transfer functions, scene composition, human psychovisual capabilities and environmental parameters on target acquisition performance. The results of this work will be in direct support of the Target Acquisition Working Group (TAWG) of the Joint Technical Coordinating Group for Munitions Effectiveness (JTCG/ME). In addition, this effort supports AFSC development goals TC-1, TC-4, RI-1, RI-5, and MS-4.

A literature survey of research dealing with direct visual and sensor-aided target acquisition will be accomplished including work done in project SEEKVAL and other TAWG-supported research efforts. Imagery from advanced sensors (thermal imaging, LLLTV, etc.) will be added to a currently existent film imagery library for use in design criteria and model-validation studies. Facilities of the display laboratory will be used to perform real-time, man-in-the-loop simulation studies to investigate key independent variables, e.g., sensor/display characteristics including resolving quality, signal-to-noise ratios, dynamic range, sensor field-of-view, etc. Additionally, the effects of various flight profiles and vehicle dynamics upon target acquisition performance will be determined. Performance characteristics of conceptual and advanced sensors and display media will be quantified and their effect convolved with image characteristics and human visual describing/demand functions to provide the requisite information for the development of a model of target acquisition. Mission scenarios derived from tactical planning documents will be used to determine how well the model is able to predict target acquisition performance. In addition, advanced signal/image processing and wide dynamic range recording techniques will be exploited to develop a family of sub-systems for enhancing the display of sensor information including spatial filtering, color enhancement, color/stereo presentations and time compression techniques. This effort was previously documented under work unit 71841102.

ADDENDA: Supporting agency address is: 6570 Aerospace Medical Rsch Lab HE, Wright-Patterson AFB, Ohio 45433

SUPPORTED BY U.S. Dept. of Defense, Air Force

6.0012, DETERMINE AIRBASE/COMMUNITY NOISE FROM AF AIRCRAFT/ENGINES OPERATING WITH GROUND RUNUP NOISE SUPPRESSORS

R.A. LEE, U.S. Air Force, Aerospace Medical Res. Lab., *Dayton, Ohio* 45433 (DF323240)

Aircraft ground runups are one of the major sources of noise on base and in surrounding communities. Many times aircraft runup noise suppressors are used to reduce the radiated energy. The Noisefile used in Noisemap presently includes only nominal design levels for such suppressors since adequate measured data as a function of angle around the source are not available. HQ USAF/PRE and MAJCOMS clearly intend to use Noisemap as a tool for assessing the need for and potential effectiveness of such multi-million-dollar suppressors in specific situations. The object of this work unit is to acquire the data needed to define the noise radiated by AF aircraft using standard runup noise suppressors in ways suitable for use by Noisemap and also for incorporation into the Noise Data Handbook.

Current plans are for four surveys to be conducted during the summer and fall of 1977 with tentative follow-up surveys the following measurement season. The four surveys in 1977 will acquire data on the A-7, F-4, F-5, F-15, F-100, F-106 and F-111 aircraft while operating in their demountable suppressors. The first survey will serve as a pilot study to determine the extent and kinds of measurements to be taken to adequately assess the noise environment with a minimum of measurements for the subsequent studies. These acoustic data will be analyzed, processed and incorporated into Noisefile/Noisemap, the community noise prediction procedure used under the USAF Air Installation Compatible Use Zone (AICUZ) program.

ADDENDA: Supporting agency address is: 6570 Aerospace Medical Rsch Lab BB, Wright-Patterson AFB, Ohio 45433

SUPPORTED BY U.S. Dept. of Defense, Air Force

6.0013, ONE-ON-ONE G/A ENGAGEMENT MODEL DEVELOPMENT

W.C. SUMMERS, U.S. Air Force, Aerospace Medical Res. Lab., *Dayton, Ohio* 45433 (DF322490)

Develop a ground-to-air attrition model for the Soviet ZSU-23-4 Anti-Aircraft artillery weapon system. This model will include an optimal control azimuth and elevation human operator submodel, an optimal control radar range human operator submodel, a model of crew discrete decisions including mode switching, an optimal control model of engagement tracking with tracers, and a model of the target acquisition process.

Evaluate exploitation documents, existing software, software under development (e.g., B.D.M. software) and field test data. Extract weapon subsystem descriptions and estimates of their inherent weapon system modelling errors. Develop software which predicts the performance of the ZSU-23-4 AAA weapon system with minimal error while maintaining run times compatible with large data base reduction on the CDC 6600 and comparable computers. Integrate human operator tracker models as completed under other 689304 work units.

ADDENDA: Supporting agency address is: 6570 Aerospace Medical Rsch Lab EM, Wright-Patterson AFB, Ohio 45433

SUPPORTED BY U.S. Dept. of Defense, Air Force

6.0014, THE DEVELOPMENT AND EVALUATION OF OBJECTIVE FREQUENCY DOMAIN BASED PILOT PERFORMANCE MEASURES IN ASUPT

E.D. MCDOWELL, Oregon State Higher Educ. Sys., School of Engineering, *Corvallis, Oregon* 97331 (DF048250; AF-AFOSR-3294-77)

AF function - the development and evaluation of frequency domain measures of pilot performance is of high interest to Air Force flying training personnel and consistent with current and planned Air Force research efforts in the area of performance measurement. Deficiency -considerable controversy exists concerning the relative merits of frequency domain versus time domain measures. The research proposed represents a major step toward resolution of the conflict which could have significant impact upon the design of future operational performance measurement systems. Objective - the possible advantages of frequency domain performance measures over more conventional time domain measures will be assessed. How research contributes - the successive organization of perception hypothesis would suggest that as human operators become more proficient at systems control tasks, their control input power spectral density curves will shift toward lower frequencies. If this hypothesis were shown to hold for flying, then it could provide the basis for developing parsimonious non-maneuver specific pilot performance measures.

Measures of pilot performance based upon a frequency domain analysis of his control inputs will be developed and then validated by comparison with instructor pilots' subjective ratings. Discriminability of these measures will be determined by demonstrating their sensitivity to pilot experience level and their marginal utility will be determined by comparing their discriminating power to those of conventional time domain criteria. The effects of simulator platform motion on instructor pilot rating abilities will be determined, and the desirability of using expanded IP rating scales in the subjective evaluation of pilot performance will be investigated.

ADDENDA: Supporting agency address is: AF Office of Scientific Research NL, Bldg 410, Bolling AFB, DC 20332

SUPPORTED BY U.S. Dept. of Defense, Air Force

6.0015, PROCEDURAL TESTS FOR ANTI-G PROTECTIVE DEVICES
R.W. THOMPSON, Technology Incorporated, *San Antonio, Texas* 78217 (DF320570; F33615-77-C-0610)

The purpose of this effort is to provide more definitive data on standard and experimental anti-g valve operational characteristics. In addition a failure analysis life expectancy of g valves will be undertaken. The final products will be (a) the development of a standard experimental technique for evaluating anti-g valves (b) a standard analytical approach for evaluating g valves and (c) a failure analysis/life expectancy prediction of a g valve.

The contractor will impose various onset rates of g and absolute g levels to g valves using the sam centrifuge while also modifying flow rates of air and inlet pressures of air to the valve. Using these experimental techniques he will develop and test an anti-g valve test protocol for reliability and producibility as a standard test procedure. Also using this technique, he will test standard and experimental valves in various modes of failure.

ADDENDA: Supporting agency address is: USAF School of Aerospace Medicine VN, Brooks AFB, Texas 78235

SUPPORTED BY U.S. Dept. of Defense, Air Force

6.0016, RESCUE AND RECOVERY EQUIPMENT
G.L. FROMME, U.S. Air Force, School of Aerospace Med., *San Antonio, Texas* 78235 (DF322100)

To test and evaluate newly developed commercial or in-house items of medical material to determine their effectiveness in the Aerospace Rescue and Recovery Service (ARRS) medical missions. The Biomedical Systems Branch has an ongoing program to evaluate medical material items to satisfy identified operational requirements for the ARRS. Performance criteria have been established to insure that medical equipment items meet stated operational requirements of the mission. Current state-of-the-art of medical material technology will be continually assessed.

The test program normally consists of six major areas: patient-user safety, operational specifications, environmental effects, electrical and mechanical characteristics, and human factors. Each area is subdivided into specific engineering tests or evaluations. Upon completion of the test program, a written report stating whether the item is or can be made acceptable is sent to the field. The information is kept on file and is updated or modified as user reports are received. This is a continuation of part of the work formerly documented under 7755-15-02.

ADDENDA: Supporting agency address is: USAF School of Aerospace Medicine NG, Brooks AFB, Texas 78235

SUPPORTED BY U.S. Dept. of Defense, Air Force

6.0017, CHEMICAL CHARACTERIZATION OF POLYCYCLIC ORGANIC MATERIALS IN AIR BASE
C.L. GIANNETTA, U.S. Air Force, School of Aerospace Med., *San Antonio, Texas* 78235 (DF320870)

Develop methodology for sampling and analysis of polycyclic organic materials (POM) that would assist AF labs such as the Environmental Health Lab in assessing the health impact of POM in air base environments.

A review of previous work will provide background for evolution of a unified scheme for sampling and analysis of POM. The concern will be for particulate POM (PPOM), vapor phase POM (VPOM) and for POM in aqueous environments. Some areas to be explored include: (1) PPOM sampling on glass fiber filters, (2) VPOM sampling on porous polymer beads in solvents and in cryogenic traps, (3) extraction of POM from filters by ultrasonic solvent extraction, (4) gross separations by compound class (aromatics, paraffinics, oxygenates, etc.) and use of this kind of separation to give low-cost sampling index to POM contamination, (5) final separation and identification by gas chromatography (GC), high-pressure liquid chromatography (HPLC), GC mass spectroscopy (GCMS) and fluorescence spectroscopy and (6) field evaluation of lab-demonstrated techniques. Prior progress in this effort has been documented under work unit 71641620. This new work unit implements new technology planning objective alignment as directed by HQ Aerospace Medical Division.

ADDENDA: Supporting agency address is: USAF School of Aerospace Medicine VN, Brooks AFB, Texas 78235

SUPPORTED BY U.S. Dept. of Defense, Air Force

6.0018, BIOMEDICAL LIMITS FOR MOLECULAR SIEVE OXYGEN CONCENTRATOR SUBSYSTEMS
K.G. IKELS, U.S. Air Force, School of Aerospace Med., *San Antonio, Texas* 78235 (DF322250)

The purpose of this work unit is to determine and define the biomedical limits of the molecular sieve oxygen concentrator subsystem. This effort is necessitated in view of the increased inert gas load in the body caused by the concurrent production of argon by the subsystem at levels 5-10 times that normally found in the atmosphere. This work unit is established to implement a new technology planning objective as directed by HQ Aerospace Medical Division.

A systematic analytical determination will be made at ground level and at various altitudes in order to define the inert gas loads in the body resulting from the wash-in of oxygen-argon mixtures and the wash-out of nitrogen. Particular attention will be addressed to conditions when the gas requirements (high workloads) placed on the subsystem are high, resulting in decreased 02 concentration and a concomitant increase in nitrogen concentration along with a 5-10 percent argon concentration. The resulting data will be used to define the boundaries of the molecular-sieve subsystem where decompression will not be hazardous to crew members.

ADDENDA: Supporting agency address is: USAF School of Aerospace Medicine VN, Brooks AFB, Texas 78235

SUPPORTED BY U.S. Dept. of Defense, Air Force

6.0019, MAJCOMS AND BASE LEVEL SUPPORT
D.H. SPOOR, U.S. Air Force, School of Aerospace Med., *San Antonio, Texas* 78235 (DF322000)

The objective of this work unit is to provide direct support to requestors for assistance through utilization of the existing aerospace medicine technology data base, the expertise of the Clinical Sciences Division staff, and where required, the expertise of USAFSAM resources outside of Clinical Sciences Division.

The approach to be utilized will involve initial Division staffing of the specific request to determine the full spectrum and scope of the endeavor, the individuals to participate in the evaluation and the assignment of OPR to a specific Clinical Sciences Division scientist. All available Division resources will be subject to utilization at one time or another including the various medical information files, the accumulated patient evaluation records from the Aeromedical Consultation Service, and also the accumulated years of aeromedical experience and judgment. Anticipated products will be summary of evaluations and analyses which may be in a simple letter reply, a USAFSAM technical report, or published paper. This is a new work unit for fiscal year 1977.

ADDENDA: Supporting agency address is: USAF School of Aerospace Medicine NG, Brooks AFB, Texas 78235

SUPPORTED BY U.S. Dept. of Defense, Air Force

6.0020, CORTISOL RISK FUNCTION
R.G. TROXLER, U.S. Air Force, School of Aerospace Med., *San Antonio, Texas* 78235 (DF321810)

Previous study has determined that USAF aircrew members with severe coronary artery disease (CAD) have increased levels of plasma cortisol, a hormone released into the blood during mental stress. Statistical analysis has shown that cortisol may be a new risk factor for coronary artery disease. The objective of this work unit is to study cortisol in all aeromedical consultation patients to determine if this relationship is constant and independent of other risk factors for CAD. A second objective is to study the effect of cortisol on the development of atherosclerosis in subhuman primates.

Plasma cortisol will be analyzed routinely on all USAF aircrew members referred to USAFSAM. Cortisol determinations on patients evaluated by coronary angiography will be statistically tested to determine if cortisol is an independent risk factor for CAD. The components of the variability of cortisol will also be defined. A controlled study using 50 nonhuman primates will compare the effect of exogenous cortisol on the rate of develop-

ment of atherosclerosis in the presence and absence of a high-cholesterol diet. This work was formerly documented under 7755-05-07.

ADDENDA: Supporting agency address is: USAF School of Aerospace Medicine NG, Brooks AFB, Texas 78235

SUPPORTED BY U.S. Dept. of Defense, Air Force

6.0021, EVALUATION OF HARMONIC ACCELERATION AS A DIAGNOSTIC TEST OF VESTIBULAR FUNCTION
J.W. WOLFE, U.S. Air Force, School of Aerospace Med., *San Antonio, Texas* 78235 (DF321650)

This effort is concerned with the delineation of parameters of harmonic (sinusoidal) angular acceleration which will aid in the diagnosis of peripheral and/or central vestibulo-oculomotor pathology in aircrew members.

Using modern analog and digital techniques, nystagmic (eye movement) data will be collected from both animal and human subjects during harmonic stimulation. These data will be analyzed for phase shift and slow phase symmetry. This study is a continuation of work formerly documented under work unit 7755-08-14.

ADDENDA: Supporting agency address is: USAF School of Aerospace Medicine NG, Brooks AFB, Texas 78235

SUPPORTED BY U.S. Dept. of Defense, Air Force

MATHEMATICAL AND COMPUTER SCIENCES

Includes Mathematical and Computer Sciences (general); Computer Operations and Hardware; Computer Programming and Software; Computer Systems; Cybernetics; Numerical Analysis; Statistics and Probability; Systems Analysis; and Theoretical Mathematics.

7.0001, A STUDY OF WAVE AND BOUNDARY LAYER PHENOMENA IN FLUID SYSTEMS
H.P. GREENSPAN, Mass. Inst. of Technology, School of Science, *Cambridge, Massachusetts* 02139 (DF047210; AF-AFOSR-3234-77)

AF function - aerospace vehicle design and operation. Opportunity - nonlinear fluid flow effects suggest new techniques for design and explain meteorological anomalies. Objective - an understanding of the implications of nonlinearities on drag, damping, turbulence, etc. How work contributes - by suggestive examples exhibiting and quantifying relevant nonintuitive effects.

The several approximations to the nonlinear partial differential equations of viscous fluid flow are treated analytically, by boundary layer techniques and numerically to obtain solutions to boundary value problems displaying effects like transition to turbulence, interactions between short and long waves, waves in stratified flows, waves on erodable boundaries, and instability and separation in a rotating fluid.

ADDENDA: Supporting agency address is: AF Office of Scientific Research NM, Bldg 410, Bolling AFB, DC 20332

SUPPORTED BY U.S. Dept. of Defense, Air Force

7.0002, DYNAMICS OF GALAXIES
C.C. LIN, Mass. Inst. of Technology, School of Science, *Cambridge, Massachusetts* 02139 (MCS75-13878 A02)

This is a continuation of research previously supported under GP-34323X3.

C. C. Lin, A. Toomre and two associates will continue their work on the development of a complete mathematical theory of the dynamics of galaxies. In addition to continuing work on individual and interacting galaxies, they will consider ring galaxies, the Milky Way System and nonlinear effects, particularly shock formation.

SUPPORTED BY U.S. National Science Foundation, Div. of Mathematical & Computer Sciences

7.0003, RESEARCH AND DEVELOPMENT OF MATHEMATICAL PHYSICAL MODELS
J. NOONAN, R D P Incorporated, *Waltham, Massachusetts* (DF249940; F19628-76-C-0212)

Research - ionospheric and stratospheric studies. How research contributes - studies of high-energy electron transport across the earth's magnetic field. Photon transport studies in the earth's stratosphere. This research will improve means for optimum performance of rockets and defense satellites.

Using mathematical and statistical techniques, models will be developed to represent physical structure and processes in the ionosphere and stratosphere. Techniques of numerical analysis and optimal digital filtering will be employed to extract meaningful information from satellites and rocket probe data. In general, noise considerations require specialized processing techniques to accomplish the above goals.

ADDENDA: Supporting agency address is: AF Geophysics Laboratory SUA, Hanscom AFB, Bedford, Mass 01730

SUPPORTED BY U.S. Dept. of Defense, Air Force

7.0004, DIFFERENTIABLE DYNAMICS AND HAMILTONIAN MECHANICS
K.R. MEYER, Univ. of Cincinnati, School of Arts & Sciences, *Cincinnati, Ohio* 45221 (MCS75-05862 A02)

This is a continuation of research previously supported under GP-37620.

K. Meyer will continue his work on the qualitative theory of ordinary differential equations with special emphasis on Hamiltonian equations. Some applications to terrestrial and celestial mechanics are anticipated. He will extend his work on bifurcation of periodic solutions to equations which admit symmetries. The restricted three-body problem and Duffing's equation are examples of such equations. The geometry of symplectic manifolds plays an important part in the study of Hamiltonian systems. New progress has been made in the understanding of holonomic and non-holonomic systems. These results should help in the computations on the satellite problem of celestial mechanics. A generic study of solenoidal minimal sets in Hamiltonian systems will be made.

SUPPORTED BY U.S. National Science Foundation, Div. of Mathematical & Computer Sciences

7.0005, COMPUTER GRAPHICS RESEARCH
C.A. CSURI, Ohio State University, School of Arts & Sciences, *Columbus, Ohio* 43210 (DF140520; AF-AFOSR-3346-77)

The use of finite-element methods for design of structural components contributes significantly to the effectiveness and efficiency of flight vehicles. Staging (structural analysis via generalized interactive graphics) is being developed to assist in using the finite-element programs more effectively. There is a need to explore new graphic techniques to support the staging effort. The objective of this effort is to investigate incorporating advanced computer graphics concepts into staging.

A preliminary investigation has revealed that significant advances have been made in model generation, languages to easily define spacio-temporal models, hidden line removal, and dynamic picture processing. The approach is to further evaluate these capabilities to determine their impact on staging, accelerate the development of the most promising areas, and begin the transition of capabilities into staging.

ADDENDA: Supporting agency address is: AF Flight Dynamics Laboratory FBRA, Wright-Patterson AFB, Ohio 45433

SUPPORTED BY U.S. Dept. of Defense, Air Force

7.0006, RESEARCH IN DIFFERENTIAL GAME THEORY
M. MINTZ, Univ. of Pennsylvania, School of Electrical Engin., *Philadelphia, Pennsylvania* 19104 (DF048690; AF-AFOSR-3327-77)

AF function - research in differential game theory for conventional Air Force weapons systems. Deficiency - mathematical models for determining evasion strategies for an aircraft threatened by a multiple-missile attack have not been fully investigated. Objective - the objective of this research is to develop an improved mathematical model which, (1) accounts for the uncertainties and modeling errors associated with the dynamics of multiple pursuing missile, and (2) leads to the determination of a suitably robust algorithm for specifying the optimal evasion state-

gies. How work contributes - success here would allow system operational planners to devise methods to avoid hostile air-to-air or surface-to-air attacks on planned air missions.

The proposed research will be divided into three related areas. First, the development of an improved mathematical model which accounts for uncertainties in the assumed missile dynamics which are used in the determination of the optimal evasion strategies will be investigated. Second, the computation of saddle-point solutions for the current mathematical/computer model developed under previous research which assumes simplified dynamics and perfect information will be pursued. Finally, there will be simulation studies to determine the sensitivity of the optimal evasion strategies to uncertainties in the underlying parameter's dynamic structure.

ADDENDA: Supporting agency address is: AF Office of Scientific Research NM, Bldg 410, Bolling AFB, DC 20332

SUPPORTED BY U.S. Dept. of Defense, Air Force

7.0007, AN INVESTIGATION OF THE EDGE-TONE EFFECT
A.M. BUONCRISTIANI, Coll. of William & Mary, Undergraduate School, *Newport News, Virginia* 23606 (NSG 1429)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

PHYSICS

Includes Physics (general); Acoustics; Atomic and Molecular Physics; Nuclear and High-energy Physics; Optics; Plasma Physics; Solid-state Physics; Thermodynamics and Statistical Physics. For Related Information See Also Engineering.

8.0001, MODERN SPECTROSCOPY OF FUNDAMENTAL ATOMIC AND MOLECULAR SYSTEMS
W.H. WING, Univ. of Arizona, School of Liberal Arts, *Tucson, Arizona* 85721 (PHY77-15217)

Research is proposed on three problems in modern spectroscopy of fundamental atomic and molecular systems. In the first project, a recently developed ion-beam infrared-laser resonance apparatus will be used to perform extremely high resolution spectroscopy and collision measurements on the hydrogen molecular ion. In the second project, precise microwave-optical spectroscopic and collision studies will be made on highly excited helium atoms. Both these systems represent three-body problems fundamental to the understanding of atomic and molecular structure. In both cases the precision achievable is several orders of magnitude greater than is achievable by conventional optical spectroscopy.

The first project has the additional potential to improve knowledge of fundamental contrasts, especially mass ratios, and also will be extended to include other ions important in astrophysics, quantum chemistry, and high-temperature gaseous and plasma processes.

In the third problem theoretically predicted and recently observed velocity-dependent sharp features in the helium-neon excitation transfer process responsible for laser action, and the velocity dependence of metastable and Rydberg helium-normal helium collisions, will be studied by a computerized time-of-flight method.

This work is a continuation of that currently supported under NSF grant number PHY75-03549A02.

SUPPORTED BY U.S. National Science Foundation, Div. of Physics

8.0002, LINEAR AND NONLINEAR OPTICAL EFFECTS IN LIQUID CRYSTALS
Y.R. SHEN, Univ. of California, School of Engineering, *Berkeley, California* 94720 (DMR76-19843)

Research on linear and nonlinear optical effects in liquid crystals previously supported by NSF grant DMR74-07361 will be continued. A new set of linear and nonlinear experiments will be initiated. Emphasis will be on the study of self focusing, measurements of the third-order nonlinear susceptibility and the use of liquid crystals as laser pulse shapers. The results of these studies should yield better understanding of the properties of liquid crystals, help in unraveling the mystery of some nonlinear optical effects and lead to potential device application.

SUPPORTED BY U.S. National Science Foundation, Div. of Materials Research

8.0003, BOOKLETS OF PHYSICS COURSE MATERIAL, TAKEN FROM CURRENT RESEARCH TOPICS
T.M. HELLIWELL, Claremont College, Undergraduate School, *Claremont, California* 91711 (SER77-02790)

The objective of our project is to bring more topics of current physics research interest into regular physics courses at Harvey Mudd College. Examples and problems used to illustrate concepts in introductory and intermediate courses are often either artificial or out of date, when there may be excellent alternatives to be drawn from current research. It is important for students to be more aware of recent developments in physics, both to improve their education and motivation as undergraduates and to help them with career choices.

The project is to prepare seven 50-page booklets on the current topics of Pulsars, Controlled Thermonuclear Fusion, Superfluids, Lasers, Planetary Magnetic Fields, Nucleosynthesis in Stars, and Solar Power. Each of the several chapters in a booklet will contain lecture material, questions, problems, and references designed to be used in a specific course. Each course can draw on chapters from at least four of the booklets.

The booklets will be written by two faculty members familiar with both topics and courses. All Harvey Mudd students will be exposed to some of the chapters in introductory courses; physics majors will learn more about the topics in their intermediate and advanced courses.

SUPPORTED BY U.S. National Science Foundation, Div. of Science Education Resources Improvement

8.0004, INTERACTION OF LIQUID HELIUM-THREE WITH MAGNETIC SUBSTRATES
W.H. PARKER, Univ. of California, School of Physical Sciences, *Irvine, California* 92664 (DMR76-20645)

This experimental program will study the interaction between helium-three nuclear spins in liquid helium-three, and electron spins in solid substrates. While an empirical awareness exists of the importance of this coupling mechanism for the transport of heat across the boundary, there has been only limited systematic experimental study of this phenomenon. At the same time, there exists a considerable body of theoretical literature on the behavior of spins near the surface of magnetic materials and recent theoretical analysis of magnetic coupling between liquid helium-three and electron spins in substrates. The investigators will experimentally study the thermal boundary impedance, and the magnetic susceptibility of the magnetic material. The emphasis will be on the temperature range 20 to 200 mk, and on careful measurements in the near vicinity of magnetic phase transitions of the substrate. The substrate material will be crystallographically ordered insulating salts and/or hyperfine enhanced magnetic materials.

SUPPORTED BY U.S. National Science Foundation, Div. of Materials Research

8.0005, THE SUPERFLUID PROPERTIES OF LIQUID HELIUM
I. RUDNICK, Univ. of California, School of Letters & Science, *Los Angeles, California* 90024 (DMR76-22306 A01)

Under NSF Grant DMR74-20823 simultaneous measurements were made of the velocity of first, second and fourth sound in superfluid Helium4 using an array of mechanical resonators. Supplementing these data with published data on the expansion coefficient and the entropy at one point, the complete thermodynamics of Helium4 were obtained from 1.2K to T and from vapor pressure to the melting curve. These measurements will be extended down to about 0.4K. Additional experiments to be undertaken with the array of resonators are: (a) a continuing study

of the healing length of superfluid as a function of P and T; (b) a study of the Helium3 excitation spectrum in Helium3-Helium4 mixtures and (c) an investigation of the nature of sound propagation in the resonators when the helium is solid. Second sound in superfluid Helium3 has never been observed. Attempts will be made to detect it and measure its velocity using a spherical resonator and a frequency of approximately 3 cps. The fountain pressure in Helium3 will be sought and if found will be used to measure the entropy. For He II in a rotating, cylindrically symmetric vessel, the vortex distribution in equilibrium is not axially symmetric. The model of a rotating, weakly interacting Bose gas will be studied in order to understand how these rotational quantum-phase transitions occur. Additionally, the elastic theory of the recently speculated supersolids will be investigated, especially to understand if and how irrotationality can be consistent with a crystal structure. Although experiments have shown that the 1/f noise is an equilibrium phenomenon, there is as yet no theoretical explanation consistent with the laws of thermodynamics. Various models will be investigated within the general framework of the theory of stationary, Gaussian, Markovian processes.

SUPPORTED BY U.S. National Science Foundation, Div. of Materials Research

8.0006, ACQUISITION OF EQUIPMENT FOR COLLISION PROCESSES INVOLVING METASTABLE ATOMS AND MOLECULES

F.T. SMITH, Stanford Research Institute, *Menlo Park, California* 94025 (PHY76-14436 A02)

This research is a continuation of that currently supported under NSF grant PHY76-14436 A01. This supplement will supply laser equipment needed to make possible precise selection of atomic excited states.

SUPPORTED BY U.S. National Science Foundation, Div. of Physics

8.0007, ELECTROMAGNETIC PROPERTIES OF LAYERED SUPERCONDUCTING STRUCTURES

M.R. BEASLEY, Stanford University, School of Hum. & Sciences, *Palo Alto, California* 94305 (DMR75-04368 A01)

This research is a continuation of work begun under NSF Grant DMR75-04368.

The superconducting properties of layered superconducting structures will be studied. These structures include the naturally occurring quasi-two-dimensional compounds and their intercalates as well as artificially produced layered thin-film composites. The objective of the research is to explore the relationship between the electromagnetic properties of these superconductors and their layered two-dimensional structure. Specifically, an effort will be made to explain the exceedingly high upper critical magnetic fields of these super-conductors and the apparent lack of Pauli paramagnetic limiting. Flux pinning in layer composites will be studied and Josephson coupling between the layers of these two-dimensional composites will be investigated.

SUPPORTED BY U.S. National Science Foundation, Div. of Materials Research

8.0008, PHOTOTHERMOELECTRIC EFFECTS IN SEMICONDUCTORS

R.H. BUBE, Stanford University, School of Engineering, *Palo Alto, California* 94305 (DMR76-20037)

This research is aimed at applying the techniques and phenomena involved in thermoelectric and photothermoelectric effects in semiconductors to a variety of basic problems in thin films of polycrystalline and amorphous material. The purpose is to identify and characterize impurity and imperfection states, and transport processes in electronically significant materials.

Research on transport in thin films will include n-type doping of zinc sulfide, zinc selenide, cadmium selenide and cadmium telluride, and p-type doping of cadmium telluride and zinc telluride. Substrate temperature and growth rate profiling during deposition will be investigated in order to optimize structural and electrical properties. Thermoelectric power will be measured as a function of grain size, crystallographic film orientation, identity and orientation of the substrate, and doping.

Studies on transport in amorphous semiconductors will include measurements of thermoelectric power as a function of temperature for amorphous semiconductors, such as (AsxGe1-x)2Te3. In addition, measurements of dark conductivity, photoconductivity, and field effect will be undertaken to better understand the transport processes in such materials.

This is a renewal of NSF Grant DMR72-03256.

SUPPORTED BY U.S. National Science Foundation, Div. of Materials Research

8.0009, THEORETICAL PHYSICS

J.D. WALECKA, Stanford University, School of Hum. & Sciences, *Palo Alto, California* 94305 (PHY77-16188)

This work represents a continuation of that currently supported by Foundation grant PHY75-18444 A01.

Research carried out will be primarily concerned with the quantum theory or many-particle systems, the structure of nuclei using elementary particles as probes, and with theories of the elementary weak, electromagnetic, and strong interactions and their consequences.

At present, specific research projects are under way on the following topics: unified analysis of semi-leptonic weak and electromagnetic interactions with nuclei, neutrino scattering from nuclei and weak neutral currents, parity violations in electron scattering from nuclei and weak neutral currents, exchange currents in nuclei, photo and electroproduction of mesons from nuclei, high-energy hadron scattering from nuclei and the theory of the optical potential, field theory of highly condensed matter, gauge theories of the elementary interactions, symmetry breaking, quark confinement, classical solutions in quantum field theories, collective excitations of atoms, and the theory of the free-electron laser (in connection with experiments at HEPL).

SUPPORTED BY U.S. National Science Foundation, Div. of Physics

8.0010, ALIGNMENT OF IONS BY PHOTOIONIZATION OF ATOMIC TARGETS

R.N. ZARE, Stanford University, Graduate School, *Palo Alto, California* 94305 (PHY77-02252)

The alignment produced by the photoionization of atom targets will be investigated. The first and most important experiment will be work on the cadmium atom: the degree of polarization as a function of the energy of the ionizing radiation. It is known that the reduced radial matrix elements vary as one changes the energy of the continuum electron, which one achieves by varying the energy of the ionizing photon. From the degree of polarization at a given photon energy the ratio of squared radial matrix elements will be obtained.

The Stanford Synchrotron Radiation Project will supply the light source required. Use of a storage ring for making these measurements has the enormous advantage over a conventional laboratory source that, in addition to its narrow tunability, it is nearly 100 percent linearly polarized. Calculations have shown that the degree of polarization to be measured increases if one uses polarized ionizing radiation. Using synchrotron radiation thereby greatly improves the accuracy with which the squared matrix element ratio can be measured above that which has already been obtained at one fixed photon energy. Moreover, it allows the determination of the variation of this ratio with the energy of the photoejected electron.

The second part of this work will be to extend the investigation of alignment into the Group IIA elements, with calcium being the first choice. Calcium is a twenty-electron atom, and its photoelectron ejection dynamics should be more amenable to calculation than those of, for example, cadmium. Thus, careful measurement of this photoionization process should prove highly instructive.

SUPPORTED BY U.S. National Science Foundation, Div. of Physics

8.0011, DEFINITION OF SPACELAB I EXPERIMENT ON HIGH-ENERGY PARTICLE DOSIMETRY

E.V. BENTON, Univ. of San Francisco, School of Science, *San Francisco, California* 94117 (NAS 9-15337)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

8.0012, THE POLARIZATION OF NE II LINE RADIATION IN H II REGIONS BY THE OPPENHEIMER-PENNEY MECHANISM

W.A. BARKER, Univ. of Santa Clara, School of Science, *Santa Clara, California* 95053 (NCA 2-685713)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

8.0013, INNER-SHELL EXCITATIONS IN HEAVY ION-ATOM COLLISIONS

Q.C. KESSEL, Univ. of Connecticut, Graduate School, *Storrs, Connecticut* 06268 (PHY76-10352 A01)

A comprehensive experimental study of the excitation of inner electron shells of heavy atoms during energy ion-atom collisions will be continued. This investigation will shed light on the quasimolecular processes (in particular, curve crossing phenomena) which occur at small internuclear separations. These small internuclear separations can only be achieved by high-energy collision processes.

This work is a continuation of that currently supported by Foundation grant PHY72-04827 AO3.

SUPPORTED BY U.S. National Science Foundation, Div. of Physics

8.0014, A STUDY OF THE ROLE OF TIME-DEPENDENT PHENOMENA IN DETERMINING SUPERCONDUCTING DEVICE CHARACTERISTICS

R.A. PETERS, Catholic University of America, School of Arts & Sciences, *Washington, District of Columbia* 20017 (ENG76-11553)

This program is concerned with establishing the way in which the superconducting phase slip and electron-phonon collision times determine: (a) the upper frequency limit for SQUID (Superconducting Quantum Interference Device) operation; (b) the relation between bridge separation and frequency limits of arrays of Josephson junctions; (c) the length of a weak link and the frequency dependence of its hysteretic effects; (d) the time necessary to nucleate a normal region in a superconductor. The program will test extensions of the quasiparticle diffusion theory into the rf region. For a given material, this work will predict maximum bridge separation of arrays as a function of frequency, the length of the weak link as a function of frequency for non-hysteretic behavior in SQUIDS, and maximum pump frequency for SQUIDS.

SUPPORTED BY U.S. National Science Foundation, Div. of Engineering

8.0015, CRYSTAL GROWTH AND MATERIAL PREPARATION

W.S. BROWER, U.S. Dept. of Commerce, Natl. Bureau of Standards, *Washington, District of Columbia* 20234 (3130130)

PURPOSE: To support development of ceramic, optical, magnetic and energy-related technologies by providing techniques for crystal growth, preparation and synthesis of inorganic non-metallics and, cooperatively, well-characterized (in terms of chemical purity and physical perfection) specimens for measurement of physical properties including optical, electrical and magnetic properties to NBS investigators and other research laboratories.

OBJECTIVES: To provide: 1) techniques for growth and synthesis of phases needed and unavailable elsewhere in energy-related (MHD, coal gasification, fuel cells, solar energy) and laser-optical fields; 2) specimens, well characterized in regard to chemical purity and physical perfection for measurements of physical properties including optical, electrical and magnetic properties for measurements at NBS, university and other government laboratories on a cooperative basis.

FY 77 MILESTONES: Develop synthesis and growth technique for phases in: 1) Alkali oxide - other oxide systems (K2O, Al2O3, Fe2O3, ZrO2) to support NBS fuel cell, MHD programs (Sept. 1977); 2) Systems containing variable valence cations such as cerium in support of NBS MHD program (Sept. 1977); 3) Rare-earth tantalate and niobate systems for NBS characterization of compounds and solid solutions formed, oxidation-reduction behavior for fuel cell applications (Sept. 1977).

ACCOMPLISHMENTS: 1) Flux growth techniques for crystals of some phases in K2O-Al2O3-SiO2, CeO2-Ta2O5, CeO2-Nb2O5 and K2-ZrO2 systems. These phases included both electrode materials under consideration and test in MHD channels and slag-electrode reaction products; 2) Synthesis of large powder samples of well-crystallized, high-purity, absolutely single phase samples of LiTa3O8 and LiNb3O8 for NBS total line profile analysis by neutron diffraction for further understanding of these laser-optical materials; 3) Compositional dependence of the tetragonal-orthorhombic transition temperature in Tl3PbC15-Tl3PbBr5 system investigated for potential application in laser-optical field.

SUPPORTED BY U.S. Dept. of Commerce, National Bureau of Standards

8.0016, THEORY OF SURFACES

J.W. GADZUK, U.S. Dept. of Commerce, Natl. Bureau of Standards, *Washington, District of Columbia* 20234 (2320251)

PURPOSE: Develop theoretical concepts and measurement procedures for the determination of surface composition, surface atomic structure and surface electronic structure for applications in science and industry.

OBJECTIVES: Provide theoretical algorithms and analytic procedures to determine surface composition, surface atomic structure, and surface electronic structure by uv photoelectron spectroscopy, X-ray photoelectron spectroscopy, and Auger-electron spectroscopy. Provide measurement procedures to determine chemical information in the application of these spectroscopies to catalytic reactions.

FY77 MILESTONES: Develop improved methods for the determination of surface atomic structure via uv photoelectron spectroscopy, Sept. 1977. Develop improved theory for the determination of surface composition via X-ray photoelectron spectroscopy and Auger-electron spectroscopy, Oct. 1977.

ACCOMPLISHMENTS: Prepared or published 30 papers and gave 23 talks describing new theories for important processes occurring in photoemission and Auger-electron emission.

SUPPORTED BY U.S. Dept. of Commerce, National Bureau of Standards

8.0017, NUCLEAR REACTIONS AND STRUCTURE STUDIES

R.H. DAVIS, State University of Fla. Sys., School of Arts & Sciences, *Tallahassee, Florida* 32306 (PHY77-08145)

This grant supports the operation of the nuclear physics laboratory which houses a model FN tandem Van de Graaff accelerator, and the research of faculty, research associates and graduate students.

Collisions of heavy ions with suitable nuclear targets will allow examination of special types of nuclear states. Examples are quasi-molecular, alpha-particle, or many particle-many hole states. Spectroscopic properties (including excitation energy, angular momentum, and decay modes) of states in medium mass nuclei will be determined using heavy-ion-induced evaporation reactions. Other work will include application of proton-induced X-ray emission identification techniques to trace element analysis, and investigation of the mechanism of atomic ionization by incident heavy ions. One part of the trace element program will be the continuing study of the elemental composition of mica inclusions with 'giant' halos utilizing improved experimental apparatus.

This work is a continuation of that currently supported by Foundation grant PHY75-03767 A03.

SUPPORTED BY U.S. National Science Foundation, Div. of Physics

8.0018, SUPERCONDUCTIVITY IN METAL-HYDROGEN SYSTEMS
C.B. SATTERTHWAITE, Univ. of Illinois, School of Liberal Arts & Sci., *Urbana, Illinois* 61801 (DMR77-08463)

This research program is a continuation of the work presently supported under NSF grant No. DMR75-13083. Its primary focus is on superconducting metal hydrides and the effect of hydrogen absorption and superconductivity of other materials. It involves synthesis of thorium and palladium hydrides and deuterides, Nb3SiHx and single-crystalline Nb3Sn. Experimental projects include: (a) the development of a high-precision specific heat apparatus and study of the low-temperature specific heat of PdHx and PdDx; (b) a study of the 50K phase transition in PdH(D)x; and (c) a study of superconducting tunneling in Th4H15. It also includes collaboration research with other groups in: (a) an EXAFS study of PdHx; (b) neutron scattering experiments on Th4H15; and (c) photoelectron emission studies in the UV and soft X-ray region of thorium hydrides.

SUPPORTED BY U.S. National Science Foundation, Div. of Materials Research

8.0019, SUPERCOOLED LIQUIDS AND GLASSES
C.A. ANGELL, Purdue University, School of Science, *Lafayette, Indiana* 47907 (DMR77-04318)

A diversified program of laboratory and computer simulation experiments, bound together by a common concern with the metastable supercooled liquid state, is being continued. Highlighted are (1) Extensions of the study of supercooled and pressurized water into the very low temperature region (T less than minus 50 degrees C) accessible above 1 kbar applied pressure. Expectations include broadened density maxima occurring as low minus 80 degrees C and interesting pressure and temperature dependencies of the mass transport properties. Structural studies (near IR spectra) may show that water can exist as a mobile liquid in the absence of identifiable 'broken' hydrogen bonds. (2) Optical studies of local structure relaxation processes in glasses in and above their transformation regions for comparison with total system responses such as enthalpy and volume relaxations. These studies are intended to throw light on the origin of the broad 'distributions' of relaxation times characteristic of liquid relaxation processes at low temperatures. (3) Spectroscopic studies of the variation in the electronic state of anions (chloride or oxide) with composition through a Lewis acid-base equivalence point. (The result will aid interpretation of the composition dependence of redox processes in oxide glasses); (4) The extended study by molecular dynamics computer simulations of liquid and configurationally arrested (glassy) states of simple ionic and molecular systems, through which correlations of thermodynamic and dynamic behavior with structural features may be obtained. This is a continuation of research supported under DMR73-02632.

This is the first year of a three-year continuing grant.

SUPPORTED BY U.S. National Science Foundation, Div. of Materials Research

8.0020, APPLICATIONS OF QUANTUM ELECTRODYNAMICS TO PROCESSES OF CURRENT INTEREST IN ATOMIC AND NUCLEAR PHYSICS
W.R. JOHNSON, Univ. of Notre Dame, School of Science, *Notre Dame, Indiana* 46556 (PHY77-15141)

This project is a two-year continuation of research on problems of current interest involving quantum electrodynamics initiated under grant PHY74-00809 A02.

Professor Johnson plans to extend his work on the RRPA to study relativistic and correlation effects in the low-frequency photoelectron spectroscopy. He plans to study the noble gases Ne, Ar, Kr, and Xe, and the period II elements Be, Mg, Hg. He expects to include RRPA calculations of autoionizing resonances in his studies. Further work on self-energy level shifts is also planned. Present numerical methods will be extended to study self-energy corrections to L and M shell binding in heavy atoms, and to examine self-energy corrections in heavy muonic atoms.

SUPPORTED BY U.S. National Science Foundation, Div. of Physics

8.0021, THEORETICAL STUDIES OF SUPERFLUID HELIUM-3
S. ENGELSBERG, Univ. of Massachusetts, School of Arts & Sciences, *Amherst, Massachusetts* 01002 (DMR74-18030 A02)

Research begun under NSF grant No. DMR74-18030 will be completed. A theoretical study of superfluid helium-3 will be made with special emphasis on studies of texture and anisotropy. In the B phase, a number of different spatial configurations of the angular momentum vector (textures) have been grown experimentally by controlling variables such as the geometrical constraints, the pressure and the magnetic field. An attempt will be made to develop a theory of these textures and to study singularities in them. In the A phase of helium-3 a number of problems dealing with nuclear magnetic resonance satellites and magnetic susceptibility will be undertaken.

SUPPORTED BY U.S. National Science Foundation, Div. of Materials Research

8.0022, ELEMENTARY PARTICLE THEORY
R. ARNOWITT, Northeastern University, School of Liberal Arts, *Boston, Massachusetts* 02115 (PHY76-11455 A01)

Theoretical research will include work on the following topics: 1. Gauge supersymmetry and unified gauge theories; 2. Pion production near threshold by neutral currents.

This work is a continuation of that currently supported by Foundation grants PHY75-14744 and PHY71-03134A04.

SUPPORTED BY U.S. National Science Foundation, Div. of Physics

8.0023, MOLECULAR BEAM, HYDROGEN MASER, AND STORED ATOM RESEARCH
N.F. RAMSEY, Harvard University, School of Arts & Sciences, *Cambridge, Massachusetts* 02138 (PHY74-12429 A03)

High-precision molecular beam magnetic resonance apparatus will continue to be used to study internal orientation-dependent interactions in molecules, such as nuclear electric quadrupole, nuclear spin-rotational and spin-spin magnetic interactions. Primary emphasis will be on non-polar molecules. The dependence of the electric and magnetic susceptibilities on molecular orientation and rotational distortion parameters of molecules will also be studied. Measurements of similar orientation-dependent interactions in polar molecules will be studied with a new molecular beam electric resonance apparatus which combines an unusually high precision electric resonance apparatus with a strong magnetic field. Atomic hydrogen masers will be studied and improved. Major improvements can be expected for a large storage box hydrogen maser with deformable walls, which has just recently come into operation. Hydrogen masers will be used to obtain more accurate values of the hyperfine separation and the effect of an electric field upon the hyperfine separation. Experiments with other stored atoms will be carried out by various methods including the hydrogen maser spin exchange technique.

This work represents a continuation of that currently supported by Foundation grant MPS-7412429.

SUPPORTED BY U.S. National Science Foundation, Div. of Physics

8.0024, EXPERIMENTAL AND THEORETICAL INVESTIGATIONS OF INTERACTION OF INTENSE RADIATION WITH ATOMS
S. EZEKIEL, Mass. Inst. of Technology, School of Engineering, *Cambridge, Massachusetts* 02139 (PHY77-07156)

The near resonant excitation of atomic systems is currently arousing very considerable interest on both the theoretical and the experimental levels. In the case of purely radiative relaxation, field intensity effects provide important verification and elucidation of quantum electrodynamics.

The virtual elimination of Doppler and collisional broadening by the use of atomic beams, along with the development of tunable lasers of high frequency stability and high intensity, have made possible the observation of a great many previously unobserved effects in saturated coherent optics. Extremely high preci-

sion studies of a number of phenomena are proposed for two-level as well as in multi-level atoms. Among these studies are: two-photon absorption, Autler-Turnes effect, coupling of two strongly driven transitions and light scattering from a strongly pumped system.

SUPPORTED BY U.S. National Science Foundation, Div. of Physics

8.0025, DEFECTS AND CONDUCTION MECHANISMS IN NONSTOICHIOMETRIC TANTALUM PENTOXIDE
H.L. TULLER, Mass. Inst. of Technology, Graduate School, *Cambridge, Massachusetts* 02139 (DMR76-21625)

This research will be a study of defects and conduction mechanisms in the nonstoichiometric metal oxide - tantalum pentoxide. This compound has utility as an insulator and barrier layer in the electronics industry.

Single crystals of high purity will be grown by chemical vapor deposition. Also, dense polycrystalline specimens will be prepared by sintering. These will be used for ionic transfer number measurements. The material will be characterized in terms of crystal structure, purity, freedom from inclusions of second phases, strain, twinning and defect concentration. Techniques to be used include X-ray diffraction, optical microscopy, scanning electron microscopy, optical absorption and mass spectrographic analysis.

Physical measurements will include: electrical conductivity and thermoelectric power at equilibrium over a wide range of elevated temperatures and oxygen partial pressures. The dependence of conductivity on oxygen partial pressure will help establish defect models. Transference number measurements will be carried out as a function of temperature and oxygen partial pressure to determine what fraction of the conductivity is ionic.

SUPPORTED BY U.S. National Science Foundation, Div. of Materials Research

8.0026, MAGNETIC MEASUREMENTS AT HIGH PRESSURE
R.P. GUERTIN, Tufts University, School of Arts & Sciences, *Medford, Massachusetts* 02155 (DMR77-05959)

Experiments will be carried out under high hydrostatic pressure to measure the magnetic properties of a variety of rare-earth alloys and compounds. The intermediate valence compound TmSe will be pressurized to 20 kbar; at these pressures the transition to Tm3 positive should be accompanied by the disappearance of metamagnetic-like transitions. The magnetic properties of paramagnetic Sm4Bi3 will be studied under pressure; magnetic ordering may be induced at high pressures as the trivalent state of Sm4Bi3 is approached. Magnetically ordered isostructural Eu4Bi3 will also be examined. Studies of crystal field singlet systems will include pressure dependence of the susceptibility of Rb2NaRF6 insulators, pressure, influenced saturation magnetization vs. ordering temperature in ferromagnetic Pr3Tl, a search for giant moments in Pr3-xGdxTl, and an investigation of crystal field-like effects in amorphous La.80-x-PrxAu.20. The ferromagnetism of CePt and isostructural UPt will be studied with magnetization, specific heat and resistivity measurements. The pressure dependence of the magnetic properties as well as studies with Ce and U doped superconducting pseudobinaries will explore similarities between lanthanide and actinide magnetism.

This is a continuation of research begun under NSF Grant 0DMR75-09494.

SUPPORTED BY U.S. National Science Foundation, Div. of Materials Research

8.0027, THEORETICAL RESEARCH IN QUANTUM GRAVITY AND PARTICLE PHYSICS
M.T. GRISARU, Brandeis University, School of Arts & Sciences, *Waltham, Massachusetts* 02154 (PHY76-02054 A01)

Work on theoretical physics will be done in the areas of quantum gravity and elementary-particle theory. In the area of quantum gravity some of the topics to be investigated deal with the question of helicity conservation in Einstein theory, breaking of symmetry in conformally invariant theories of gravitation, and the computation of scattering amplitudes for processes involving gravitons. In elementary-particle theory the main topics deal with the question of Reggeization of elementary particles, and certain properties of the S-matrix in supersymmetric theories stemming from the fact that fermion and boson amplitudes are related by the symmetry.

SUPPORTED BY U.S. National Science Foundation, Div. of Physics

8.0028, HYPERFINE INTERACTION STUDIES IN MAGNETICALLY ORDERED SOLIDS, WITH APPLICATION TO CRITICAL PHENOMENA AND LATTICE DEFECTS
C. HOHENEMSER, Clark University, Graduate School, *Worcester, Massachusetts* 01610 (DMR77-01250)

A series of experiments will be done to study the effect of disorder on critical exponents. Disorder will be introduced into ferromagnets both through nonmagnetic impurity atoms and through lattice defects. Other projects include further work on critical fluctuations, studies of Mossbauer energy shift oscillations near Tc; and a crucial test of the probe independence hypothesis. In addition, a comprehensive review of critical point studies with hyperfine field techniques including perturbed angular correlations (PAC), Mossbauer effect, and nuclear magnetic resonance will be undertaken. Samples with defects will be prepared by charged particle bombardment and quenching of Mossbauer and PAC sources. The defects will be detected by trapping on hyperfine probe nuclei through suitable annealing sequences. In following this approach, it is hoped to obtain information about structure and migration complementary to that using non-implantation and ion-beam methods.

This is a continuation of work begun under NSF Grant No. DMR75-02982; this is the first year of a 3-year continuing grant.

SUPPORTED BY U.S. National Science Foundation, Div. of Materials Research

8.0029, A SEARCH FOR NEUTRAL CURRENT INTERACTIONS IN ATOMIC HYDROGEN AND DEUTERIUM
R.R. LEWIS, Univ. of Michigan, School of Lit. Sci. & The Arts, *Ann Arbor, Michigan* 48104 (PHY76-02855 A02)

This experimental program will measure the coupling constants for the parity-non-conserving (PNC) weak e-p and e-n interactions in atomic hydrogen and deuterium. The rate of emission of Lyman-alpha from H and D will be measured for metastable beams passing suddenly through a static electric field. These decays result from both a Stark admixture and a weak PNC admixture of the 2P 1/2 state into the original 2S 1/2 state. The preferential absorption of right or left circularly polarized Balmer-alpha radiation in the 2S 1/2 yields 3S 1/2 transition will be measured for metastable beams of atomic H and D in crossed electric and magnetic fields. This absorption results from a nonresonant or suppressed Stark admixture and a resonantly enhanced weak PNC admixture of nearby P-states.

This work is a continuation of PHY76-02855.

SUPPORTED BY U.S. National Science Foundation, Div. of Physics

8.0030, THEORY OF HIGH-ENERGY ION-ATOM AND ATOM-ATOM COLLISIONS
J.S. DAHLER, Univ. of Minnesota, School of Engineering, *Minneapolis, Minnesota* 55414 (CHE76-11037 A01)

This research involves the development and testing of efficient theoretical procedures for estimating the cross section (both differential and total) for a variety of the excitation and quenching processes that take place in high-energy (approximately 1 - 200 keV) ion-atom and atom-atom collisions. Among the many systems to be considered are alkaline earth ion-rare gas and alkali metal-rare gas pairs, e.g., Be ion, Mg ion,.../He,... Ne,... and Li, Na,.../He, Ne...Xe. The processes of interest include excitation and quenching of the projectile alkaline earth ions and alkali atoms, excitation of the target rare gas, charge exchange, and electron detachment. The plan involves the systematic investigation of a variety of scattering theory approximations including solution of the close coupled equations of the

impact parameter method and Born and distorted wave Born approximations. Great emphasis is placed upon the testing and evaluation of different models for the electronic Hamiltonian operator or, more specifically, of the pseudo-potentials which are used (either explicitly or implicitly) to represent interactions of the electrons with the many-electron 'cores' of the projectile and target species.

SUPPORTED BY U.S. National Science Foundation, Div. of Chemistry

8.0031, TRICRITICAL PHENOMENA AND DYNAMICS OF HYDROGEN-BONDED CRYSTALS
V.H. SCHMIDT, Montana State University, School of Letters & Sciences, *Bozeman, Montana* 59715 (DMR76-11828 A01)

Dielectric, nuclear magnetic resonance (NMR), and optical studies of potassium dihydrogen phosphate and other suitable crystals are being made at various temperatures and electric fields, particularly in the vicinity of the 'wing' critical point. These measurements are made at various pressures in order to search for possible tricritical points at which the critical fields approach zero. Dynamic behavior, clustering, and phase separation near critical and tricritical points will be examined.

This is a continuation of research supported under DMR74-13220.

SUPPORTED BY U.S. National Science Foundation, Div. of Materials Research

8.0032, LARGE-AMPLITUDE ION ACOUSTIC WAVES ON THE BEAM-PLASMA INSTABILITY
R.F. ELLIS, Dartmouth College, School of Arts & Sciences, *Hanover, New Hampshire* 03755 (DF049590; AF-AFOSR-3410-77)

AF function - operation of high-altitude vehicles in a post-nuclear explosion environment, development of electromagnetic weapons, space and ionospheric communications as well as countermeasures demand advanced equipment unavailable to date. Deficiency - present-day information is inadequate to design the aforementioned equipment. Such information may be obtained from experimental and theoretical work on beam-plasma nonlinear interactions. Objective - this project will investigate the effects of large-amplitude ion acoustic waves on the beam-plasma instability. Contribution - this work is a part of a comprehensive program on plasma research for the development of an X-ray radiation source for simulation of nuclear weapon effects, the development of advanced electromagnetic weapons (laser and ion beam), the development of space and ionospheric communications and the development of countermeasures.

This project will perform experiments on a fast electron beam which is propagated in a plasma containing large-amplitude short-wavelength ion acoustic waves. In these experiments the following processes appear: (a) the beam drives a long-wavelength plasma wave unstable, (b) this wave couples its energy strongly to a much shorter wavelength plasma wave. From the foregoing it is expected to isolate the effect of large-amplitude ion acoustic waves upon the beam-plasma instability. The procedure will be as follows - the beam plasma instability will be studied both with and without the externally generated ion waves. The growth and saturation of the instability will be measured with probes. The energy distribution of the plasma and the beam will be measured with gridded energy analyzers. According to theory it is expected that the ion waves will produce a reduction in the saturation level of the primary beam-plasma wave, large electron wave sidebands and enhancement of the energy transferred to plasma particles. A wide range of plasma beams and wave parameters will be studied to understand the coupling of energy from one frequency plasma wave to another. These measurements will be made for both coherent ion waves and turbulent ion waves.

ADDENDA: Supporting agency address is: AF Office of Scientific Research NP, Bldg 410, Bolling AFB, DC 20332

SUPPORTED BY U.S. Dept. of Defense, Air Force

8.0033, USE OF THE MOSSBAUER EFFECT IN STUDIES OF ELECTRONIC AND VIBRATIONAL STRUCTURE
G.M. ROTHBERG, Stevens Institute of Technol., Graduate School, *Hoboken, New Jersey* 07030 (DMR77-09911)

Research on electronic and vibrational structure in solids by means of the Mossbauer effect will be carried out. Techniques have been developed to extend the usefulness of the Mossbauer effect through observation of the internal conversion and Auger electrons that are emitted after a Mossbauer absorption. New kinds of experiments are possible and others may be enhanced by improved signal-to-noise ratios. Electrostatic electron energy analyzers have been constructed with properties especially suited to conversion electron spectroscopy (CES). Measurements of electron spin densities in magnetic materials will be continued. This work deals with fundamental aspects of magnetism in solids as manifested by core and conduction electron polarization. Experiments will also be carried out in which the energy loss by the electrons in traversing the Mossbauer absorber is used to determine the depth at which they were produced. A great variety of surface-related phenomena may be studied in this way. Further development of the CES technique will also be carried out.

This is a continuation of research begun under NSF grant No. DMR72-03034.

SUPPORTED BY U.S. National Science Foundation, Div. of Materials Research

8.0034, ELECTRON CORRELATIONS AND PROPERTIES OF METALS AND INSULATORS
D.C. LANGRETH, Rutgers The State University, School of Arts & Sciences, *New Brunswick, New Jersey* 08903 (DMR77-08694)

Theoretical investigations of many-electron systems in condensed matter previously supported by NSF grant DMR-7509804 will be continued.

Specific topics to be addressed include: the effect of electron correlations near surfaces of metals, surface energy of metals, and related structural properties; exchange and correlation in non-uniform systems and the approximate methods used in them; real metal properties including magnetic effects; and high-energy excitations in solids, including the theory of high-energy probes of solids such as photon, photoelectron, and electron spectroscopies. These will be studied both with respect to bulk and surface properties.

SUPPORTED BY U.S. National Science Foundation, Div. of Materials Research

8.0035, STATISTICAL MECHANICS
J.L. LEBOWITZ, Rutgers The State University, Graduate School, *New Brunswick, New Jersey* 08903 (PHY77-22302)

Research in theoretical physics initiated under NSF grant PHY75-20638A01 at Yeshiva University will continue. Topics in statistical mechanics to be investigated include: 1. Ergodic theory; 2. stability of equilibrium states; 3. steady-state transport theory; 4. metastability; 5. properties of correlations in equilibrium systems; 6. constructive quantum field theory.

SUPPORTED BY U.S. National Science Foundation, Div. of Physics

8.0036, THEORETICAL NUCLEAR PHYSICS
A. MEKJIAN, Rutgers The State University, School of Arts & Sciences, *New Brunswick, New Jersey* 08903 (PHY77-00478)

Theoretical research initiated under Grant PHY75-06858-A01 will be continued. Topics in theoretical nuclear physics to be investigated include: Aram Mekjian: 1. Muon capture in nuclei; 2. Isobaric analog resonances; 3. Photonuclear reactions; 4. Inelastic electron scattering; 5. Heavy ion scattering. Larry Zamick: 1. Collective theories of giant resonance states; 2. Effective charge with and without scaling; 3. Isoscalar magnetic moments; Nuclear compressibility and isotope shift; 5. Hartree-Fock theory for a closed shell plus one nucleon; 6. Coulomb energy differences and radii.

SUPPORTED BY U.S. National Science Foundation, Div. of Physics

8.0037, KONDO SCATTERING STUDIED BY ELECTRON TUNNELING
S. BERMON, City University of New York, School of Liberal Arts & Sci., *Flushing, New York* 11367 (DMR76-17379)

Electron tunneling will be used to study the Kondo effect in metals. By measuring the voltage dependence of the dynamical resistance of metal-insulator-metal tunnel junctions which contain magnetic impurities in one of the metals, one can deduce the energy dependence of the density of states for the impurity. Data from these measurements gives much more detailed information about the impurity state than previously available in that, earlier measurements gave only a measure of an average overall energies. Preparation of junctions with the proper atomic species in the proper locations is difficult and the development of sample preparation techniques will be a central part of the research. By measuring the dependence of the resistance peak at zero bias on the distance of the impurity from the oxide interface, the momentum dependence of the exchange coupling constant Jkk' in the s-d model can be determined.

SUPPORTED BY U.S. National Science Foundation, Div. of Materials Research

8.0038, OPERATIONAL SUPPORT - CORNELL ELECTRON SYNCHROTRON
B.D. MCDANIEL, Cornell University, School of Arts & Sciences, *Ithaca, New York* 14853 (MPS-6700052 A31)

Research at the Cornell Laboratory for Nuclear Studies is a multi-faceted effort and consists primarily of the following major efforts. 1. Experiments on electroproduction of states of matter which study high-energy electron scattering by protons. These experiments, utilizing streamer chambers, proportional wire chambers and magnetic spectrometers, are designed to yield information on the nature of nucleon structure. 2. An intensive research and development on the problems and characteristics of electron storage rings. The activity is precursor to the storage ring facility to be constructed in the future and is vital for ensuring a proper and successful design of that facility. 3. A program to study the phenomenon of super conductivity with applicability towards the development of superconducting r.f. cavities. The technology will have important ramifications on the design of new particle accelerators.

This work represents a continuation of that currently supported by Foundation grant PHY67-00052-A028.

SUPPORTED BY U.S. National Science Foundation, Div. of Physics

8.0039, DEFECTS AND DEFECT MOBILITY IN IONIC CRYSTALS
A.S. NOWICK, Columbia University, School of Engineering, *New York, New York* 10027 (DMR77-07141)

Research on point defects in ionic crystals continues, employing measurements of ionic conductivity and relaxation phenomena. Of major interest is a study of diffusion of Li ion into MgF2 crystals, and the associated ionic conductivity, since Li ion has been found to be a fast diffusor in MgF2 (via interstitial migration). The discovery of a low-temperature internal friction peak due to Li2 pairs provides a useful auxiliary tool for this investigation. Previous studies utilizing both dielectric and anelastic relaxation in non-cubic crystals will be extended to the tetragonal crystal paratellurite (TeO2) containing appropriate dopants; this crystal will also allow a study of piezoelectric relaxation.

An investigation of protonic hydrogen (H ion) as a defect in ionic crystals is under way, with the initial investigation on NaNO3 and LiIO3 crystals. It is desired to introduce H ion and to determine its site occupancy, activation energy for migration, and interaction with other defects.

Finally, various extensions of the theory of relaxation phenomena continues.

This is a continuation of research supported under DMR 75-09603. First year of a three-year continuing grant.

SUPPORTED BY U.S. National Science Foundation, Div. of Materials Research

8.0040, MEASUREMENTS OF CP VIOLATION AND CHARMED PARTICLE PRODUCTION
J.H. CHRISTENSON, New York University, School of Arts & Sciences, *New York, New York* 10012 (PHY77-20035)

A two-part program of investigation using the Brookhaven Alternating Gradient Synchrotron will be conducted. 1. Measurement of CP Violation Parameters in Neutral Kaon L Decay. This experiment to measure the magnitude and phases of the decay amplitudes involved in the decays neutral kaon L yields positive pion negative pion and neutral kaon L yields neutral pion neutral pion is in the advanced phases of data analysis and is expected to provide the best tests to date of the super-weak explanation of CP violation in weak decay processes. 2. Charmed Particle Production by Hadrons. Preparation for this experiment will be initiated with the development of prototype detector units and the detailed design of the experiment. Included in the latter category will be extensive Monte Carlo calculations to determine acceptances, biases, rates and backgrounds. The experiment has as its goal the observation of two- and three-body final states of charmed particles hitherto unknown.

This work represents a continuation of that currently supported by Foundation grant PHY76-22318.

SUPPORTED BY U.S. National Science Foundation, Div. of Physics

8.0041, A THEORETICAL INVESTIGATION OF ATOMIC SCATTERING PROCESSES
L. ROSENBERG, New York University, School of Arts & Sciences, *New York, New York* 10012 (PHY77-10131)

Research in theoretical atomic physics initiated under NSF grant PHY75-00131 A01 will be continued. Among the topics to be investigated are: 1. variational principle for the scattering length; 2. electron atom scattering in the presence of a laser field; 3. double scattering processes; 4. variational methods for matrix elements; 5. expansion of matrix elements in powers of l/k; 6. upper and lower variational bounds.

SUPPORTED BY U.S. National Science Foundation, Div. of Physics

8.0042, PROPERTIES OF MATTER CHANGING PHASE
G. STELL, State University of New York, School of Arts & Sciences, *Stony Brook, New York* 11790 (DMR73-07580 A01)

Research on the theory of phase transitions, previously supported under DMR-7307580, will be continued. This is a statistical-mechanical study of the bulk properties - thermodynamic, dielectric and structural - characteristic of matter in or near a change of phase. It entails the continuing development of certain general formalisms applicable to a wide class of systems as well as the specific study of representative problems. These concern the dielectric constant and index of refraction, metamagnetism, adsorption and absorption, hypercriticality, and phase transitions in soft-core metals, fused salts, and related systems.

SUPPORTED BY U.S. National Science Foundation, Div. of Materials Research

8.0043, MAGNETIC RESONANCE STUDIES OF DEFECT BEHAVIOR IN PEROVSKITE AND RUTILE STRUCTURED MATERIALS
L.E. HALLIBURTON, Okla. St. Univ., School of Arts & Sciences, *Stillwater, Oklahoma* 74075 (DMR77-08465)

This research was previously supported under DMR 73-07656.

The principal goal of this research program is to determine the formation mechanisms and resulting electronic structure of defects in perovskite and rutile structured halides. Specifically, the self-trapped exciton triplet states in KMgF3 and MgF2 will be investigated by combining optical and magnetic resonance techniques. The results of these experiments will provide a better understanding of the photochemical damage process in low-symmetry materials. The second area of investigation will be the magneto optic properties of luminescing Mn2 ion-F center exchange coupled close pairs in KMgF3. Finally, electron-nuclear double resonance (ENDOR) studies of the self-trapped hole and the im-

purity-associated fluorine interstitial centers in KMgF3 will be continued, as well as extension of this work to an electron spin resonance (ESR) investigation of interstitial centers in RbCaF3.

SUPPORTED BY U.S. National Science Foundation, Div. of Materials Research

8.0044, PHONON INTERACTIONS WITH STRONGLY COUPLED IMPURITIES IN CRYSTALLINE SOLIDS
J.N. LANGE, Okla. St. Univ., School of Arts & Sciences, *Stillwater, Oklahoma* 74075 (DMR76-19594 A01)

The properties of impurities in insulating crystals will be studied. In particular, those impurities which strongly couple to the host lattice and which therefore strongly influence the transport properties will be investigated.

It has been demonstrated previously that features in the temperature dependence of the acoustic attenuation can be related to the presence of the impurities and analyzed to yield information about low-level thermal excitations of the impurity. The results of those observations will be interpreted in terms of the dynamic Jahn-Teller effect and parameterized as tunnel splittings or spin-orbit reduction factors. The specific ions of interest will be Fe ions, Cr ions, and Mn ions in the host crystals KMgF3 and RbMgF3. This investigation will first emphasize characterization of isolated impurity ions and then progress to the study of pair interactions in highly doped systems. The object is to investigate superexchange coupling between the pairs.

This is the continuation of research previously supported under DMR76-19594.

SUPPORTED BY U.S. National Science Foundation, Div. of Materials Research

8.0045, THEORY OF ELEMENTARY PARTICLES
M.J. MORAVCSIK, Oregon State Higher Educ. Sys., Inst. of Theoretical Science, *Eugene, Oregon* 97403 (EY-76-S-06-2230 0004)

During the past year work was done in the following areas: 1. Predictions of the quark model. 2. e positive e negative annihilation in the color 6 model. 3. Six-quark gauge model. 4. Broken gauge symmetry and asymptotic freedom. 5. Rescattering corrections in quark counting. 6. Mass differences in the bag model. 7. Quark model for weak interactions. 8. Weak interactions in SO(4) x U(1). 9. Reggeon field theory. 10. Topological expansions. 11. Solutions of the Yang-Mills equation. 12. Parton-free models. 13. Dual interference model. 14. Asymptotic freedom. 15. Higgs bosons. 16. Flavored pomerons. 17. New lepton matter. 18. Psi-proton scattering. 19. Inclusive production. 20. Off-shell polarization effects. 21. Atomic scattering and polarization. 22. Determination of amplitudes. 23. Overview of polarization. 24. Energy radiated from storage rings. 25. Foundations of hydrodynamics theories. 26. Assessment of particle physics.

RESULTS: A large number of research articles, published for the most part in Physical Review, Physical Review Letters and Physics Letters. Preprints available from the Institute as long as the supply lasts.

SUPPORTED BY U.S. Energy Research & Development Admin., Div. of High Energy & Nuclear Physics

8.0046, EXCESS FREE CARRIER PLASMAS IN SEMICONDUCTORS BY MEANS OF FAST TRANSIENT INFRARED SPECTROSCOPY
H.J. GERRITSEN, Brown University, Graduate School, *Providence, Rhode Island* 02912 (DMR76-81865)

Dense and non-equilibrium plasmas in semiconductors will be investigated by experimentally using time-resolved spectroscopy. The density of the free carrier plasma generated by picosecond laser pulses of variable intensity will be studied. The time dependence of the plasma density will be measured and related to diffusion and recombination kinetics. The studies will concentrate on germanium and gallium arsenide as the host for the plasma.

SUPPORTED BY U.S. National Science Foundation, Div. of Materials Research

8.0047, EXPERIMENTS AT LOW TEMPERATURE
G.M. SEIDEL, Brown University, Graduate School, *Providence, Rhode Island* 02912 (DMR77-09593)

Research begun under NSF grant DMR73-07493 will be continued and extended. A new technique for measuring the density of helium gas has been developed and will be used to establish a more accurate temperature scale from 2 to 20 Kelvin. The resonant frequency of a superconducting microwave cavity will be used to measure the density of helium gas at low temperatures to an accuracy heretofore unattainable. The goal of the research is to establish a temperature scale one order of magnitude more accurate than the one now in use. This same microwave technique will also be applied to other problems as time and resources permit. The dispersion relation of helium-3 quasiparticles in helium-4 will be studied and investigations of the density of helium along the melting curve will be undertaken.

SUPPORTED BY U.S. National Science Foundation, Div. of Materials Research

8.0048, SURFACE QUANTIZATION AND ELECTRON-ELECTRON INTERACTIONS
P.J. STILES, Brown University, Graduate School, *Providence, Rhode Island* 02912 (DMR77-10218)

Experimental studies of the electronic transport properties of inversion and accumulation layers in semiconductors will be continued. This is an extension of research previously supported by NSF grant DMR-7302401. Measurements of the magnetoconductivity, Shubnikov-de Haas effect, cyclotron resonance will be used to investigate the one-electron states as well as the one-electron and many-electron excitations of the quasi-two-dimensional (Q2D) electron gas localized at the interface between silicon and silicon dioxide. Specific topics to be addressed include: the formation of superlattices in Q2D systems; measurement of Q2D plasmons; electron-phonon interactions in Q2D electron systems; and the localization of electronic states due to potential fluctuations.

SUPPORTED BY U.S. National Science Foundation, Div. of Materials Research

8.0049, OPTICAL STUDIES OF ELECTRONIC STATES, VIBRATIONS AND RELAXATION PROCESSES IN AMORPHOUS SYSTEMS
J. TAUC, Brown University, Graduate School, *Providence, Rhode Island* 02912 (DMR76-17443 A01)

Research on amorphous and liquid semiconductors previously supported by NSF grant DMR-7617443 will be continued. Work on the electronic states in the gap of amorphous and liquid semiconductors, in particular on the absorption tails below the gap in amorphous and liquid As2S3 doped with various impurities such as Fe will be continued. Experimental and theoretical studies of the temperature dependence of the Raman spectra, in particular on the changes that occur when one passes through the glass-transition will be carried out. The previous work will be extended to include organic glass-formers. The Raman spectra of samples in the form of optical waveguides (fibers or thin films) will be measured with the aim of studying vibrations at the interface. Studies of fast relaxation processes in liquids and glasses in the picosecond range will be initiated. For this work a picosecond dye-laser system will be set up. The first experiment will deal with the relaxation of a hot vibrational mode over a broad temperature range that includes the glass transition.

SUPPORTED BY U.S. National Science Foundation, Div. of Materials Research

8.0050, NUCLEAR SPECTROSCOPIC STUDIES
C.R. BINGHAM, Univ. of Tennessee, School of Liberal Arts, *Knoxville, Tennessee* 37916 (EY-76-S-05-4936)

The proposed research involves studies of nuclear states by a variety of techniques, including on-line mass separation of radioactive species with the UNISOR facility, population of high-spin states by heavy-ion induced reactions, measurement of static moments of states by heavy-ion inelastic scattering, semiclassical calculations of the inelastic scattering of heavy ions by nuclei, and

theoretical calculations with triaxial-rotor coriolis-mixing models. The interpretation of the UNISOR results on 193, 195, 197 Tl from Pb decay will include a description of the impressive structure built on the h9/2 proton state in terms of triaxial shapes for Hg cores. The position of the single proton states will be traced to the other side of the Z equals 82 gap through recently started UNISOR studies of odd-A Bi isotopes from the decay of Po parents. Additional UNISOR studies of Po200, Bi200, and light Lu decays are proposed. The proposed research also includes studies of high-spin states in odd-A Tl and Au nuclei by (HI, xn gamma) techniques, to search for shape changes at high spin in various high-j proton states. The measurement of quadrupole moments in sd shell nuclei by means of coupled-channels analysis of inelastic scattering cross sections is proposed as an additional test of extensive shell model calculations in this region. Measurements of the Coulomb-nuclear interference for high-spin states in deformed nuclei will be performed using gamma-ray techniques.

SUPPORTED BY U.S. Energy Research & Development Admin., Div. of Basic Energy Sciences

8.0051, THE ROLE OF ELECTRON ACCELERATORS IN U.S. MEDIUM-ENERGY NUCLEAR SCIENCE

R.S. LIVINGSTON, U.S. Energy Res. & Dev. Admin., Oak Ridge National Lab., *Oak Ridge, Tennessee* 37831 (PHY77-10433)

It is proposed to conduct a study of the role of electron accelerators in U.S. medium-energy nuclear science. A group of about ten scientists acquainted with this area of research will be chosen to study the field and issue a report by June 30, 1977. The study group will review the fundamental questions in nuclear science which might be investigated by the use of electron accelerators in the medium-energy range, will attempt to evaluate the overall scientific potential and opportunities in this area of nuclear science, and will try to determine the experimental needs for beam energy, intensity, energy resolution, phase space and duty factor, as well as for auxiliary equipment and operational support. The study will consider whether it is feasible and desirable to construct a new electron accelerator facility, and whether the needs and opportunities might alternatively be met by the use of existing accelerator facilities or improvements of them. The study will attempt to present a coherent national program that will address the needs and opportunities in an optimal way, taking into account technical feasibility, cost, time scale, manpower availability, institutional appropriateness and foreign competition.

SUPPORTED BY U.S. National Science Foundation, Div. of Physics

8.0052, PLASMA FORMATION PROCESSES IN A CYLINDRICAL SHELL GEOMETRY

R.D. BENGTSON, Univ. of Texas, School of Natural Sciences, *Austin, Texas* 78712 (DF047950; AF-AFOSR-3259-77)

AF function - the AF has a requirement to harden systems to decrease the vulnerability to radiation damage from nuclear weapons detonations. To test system vulnerability, laboratory radiation generators must be built to simulate these radiation effects. Deficiency - present laboratory radiation generators cannot simulate in a realistic fashion the radiation intensity and spectrum of a nuclear weapon over a sufficiently large volume. Objective - the Air Force Weapons Laboratory has a program to investigate the feasibility of using a magnetically imploded metal foil to form a high-temperature plasma for use as a radiation source. This program is complementary to that at AFWL. Here the feasibility of replacing the metal foil with an annular gas shell is examined. The gas shell would have the advantage of allowing lower initial masses and therefore higher implosion velocities and therefore plasma temperatures and would also allow the use of a wider variety of materials than are available in solid foils. Contribution - this research will contribute to the development of plasma radiation sources for weapons effects simulation.

The initial phases of plasma formation are often crucial to the later behavior of many plasma devices, particularly when conditions of nearly full ionization are required in a particular geometry. The concept of forming a high-temperature, high-density plasma by electromagnetic implosion of a metal foil cylinder has been studied at AFWL. If the metal foil is replaced by a larger radius, lower mass cylindrical shell plasma, a higher temperature compressed plasma can be produced with smaller stored energy. A major goal of this experiment will be to develop and characterize a plasma shell suitable for implementation in the imploding liner program at AFWL/DYS. Primary attention will be focused on producing a cold gas shell and obtaining a high degree of ionization in a time period less than 10 microseconds. The time evolution of the plasma will be studied with optical spectroscopy and laser interferometry. This data will be used as the basis for analyzing the physical-chemical reactions important to forming the initial plasma. The formation of the foil will be studied with various gases including hydrogen, helium, neon, and argon. The intended gas shell parameters are as follows - mass equals 10-3 gm, radius equals 20 cm, height equals 2 cm, background densitv 10-5 torr.

SUPPORTED BY U.S. Dept. of Defense, Air Force

8.0053, INVESTIGATION OF MAGNETIC AND NUCLEAR SPIN ORDERING EFFECTS IN QUANTUM SOLID HELIUM-3

W.P. KIRK, Texas A & M University System, Graduate School, *College Station, Texas* 77843 (DMR76-09807 A01)

The main objective of this research is to perform measurements relating to the magnetic and spin ordering properties of solid He3 that have yet to be investigated in detail at temperatures less than 50 millikelvin, where the exchange energy effects are most pronounced. Emphasis will be placed on using NMR spectroscopy to study dynamic properties such as spin diffusion and thermodynamic properties such as the magnetic susceptibility. The results of this effort could provide the essential information for a significant breakthrough in our understanding of the exchange energy effects and the spin ordering process in quantum crystals.

SUPPORTED BY U.S. National Science Foundation, Div. of Materials Research

8.0054, EFFECTS OF CHEMICAL BONDING ON ION-INDUCED X-RAY PROCESSES

T.J. GRAY, North Texas State University, School of Arts & Sciences, *Denton, Texas* 76203 (B-571)

Further studies of inner-shell ionization by projectiles with atomic numbers Z1 equals 1 to Z1 equals 9 on both the K- and L-shell electrons have been completed. Two major conclusions have been formulated from the studies performed to date: (1) The use of a perturbed plane-wave Born approximation (PWBA) as formulated by Brandt and co-workers is required in the description of inner-shell ionization by heavy ions and (2) the perturbed calculations, while giving better agreement between theory and experiment, are in need of reformulation to account for a dynamic change in the electron configuration in lieu of the static approximation used by Brandt et al. The use of a modified binding energy approach causes the reduction in the magnitude of the PWBA ionization cross sections as required to be in better agreement with the experimental data. However, the observed structure in the 2s-ionization cross section is not preserved by the binding energy correction.

Additional work in progress has shown that the comparison of PWBA calculations with or without perturbation corrections is not valid for heavy ions like F, Al, Si and Cl on Cu targets. The influence of K-vacancy creation and annihilation for the projectile causes a strong target thickness dependence.

SUPPORTED BY Robert A. Welch Foundation

8.0055, K-SHELL X-RAYS FROM TI, NI, GE, AND RB FOR INCIDENT IONS FROM 1H TO 35CL IN THE ENERGY RANGE FROM 1-3 MEV/AMU

F.D. MCDANIEL, North Texas State University, Graduate School, *Denton, Texas* 76203 (B-629)

A systematic study of ion-induced X-ray production for the K-shell is described. X-ray production cross sections, K alpha/K beta ratios, and X-ray energy shifts are presented for representative targets of Ti, Ni, Ge, and Rb for incident ion species of 1H, 4He, 7Li, 2Cl, 4Nl, 19F, 28Si, and 35Cl. Measurements over an

incident ion energy range from 1-50 MeV were made using 2.5 MV and 6 MV single-ended Van de Graaff accelerators and a 7 MV tandem accelerator. X-rays were detected with a lithium drifted silicon X-ray detector with a FWHM resolution of 175 eV at 6.0 KeV. Trends observed in the experimental results as a function of incident ion species, incident ion energy, and target atom are presented. The experimental cross sections are compared to theoretical models of Coulomb ionization which are used to describe ion-atom interactions. These models include the Binary Encounter Approximation (BEA) and the Plane Wave Born Approximation (PWBA) with corrections for Coulomb deflection of the incident projectile and increased electron binding. Calculations of polarization and relativistic effects are also included for some of the results.

SUPPORTED BY Robert A. Welch Foundation

8.0056, CONFIGURATIONAL INSTABILITIES IN POINT DEFECTS IN CRYSTALS

T.L. ESTLE, Rice University, Graduate School, *Houston, Texas* 77001 (DMR76-07812 A01)

Research previously supported by DMR76-07812.

This research program is a coordinated experimental and theoretical study of defects in solids which are coupled to vibrational modes so that several equilibrium geometrical configurations with different orientations exist. The best known of these is the Jahn-Teller effect but other types of vibronic and nonvibronic coupling lead to somewhat similar results. Electron paramagnetic resonance spectra for orbital-doublet impurity ions, orbital-triplet ions, and off-center impurity ions will be studied. These spectra will provide information about the distortions, evidence of dynamic behavior in quasi-static systems, and useful systematic data. The experimental results will be compared to theory. Calculations of adiabatic potential energy surfaces will be made. In addition, for some cases the resultant eigenvalue problem will be solved for the vibronic states.

SUPPORTED BY U.S. National Science Foundation, Div. of Materials Research

8.0057, THERMODYNAMICS AND DIFFUSION KINETICS OF INTERSTITIAL SOLID SOLUTIONS

R.B. MCLELLAN, Rice University, Graduate School, *Houston, Texas* 77001 (C-281)

A study has been made of the composition variation of the diffusivity of an interstitially dissolved chemical species in the presence of a solute atom gradient. It has been shown the diffusion coefficient at a given point in a chemical gradient is not affected by the magnitude of the gradient, except when this is very large, but by the composition coefficient of the saddle point activation energy. The predictions of this calculation have been shown to be in excellent agreement with C-diffusion in fcc iron measured in diffusion couples both with and without a composition gradient.

It has been shown that the diffusivity of nitrogen in bcc iron shows the same type of positive deviation from Arrhenius behavior as is exhibited by the C-bcc-Fe system. A theoretical analysis indicates that both anomalies are rooted in the ferromagnetic behavior of the iron solvent metal. The activation free-energy necessary to excite a diffusing atom into a saddle-point configuration contains a magnetic component which varies with temperature and becomes zero when the Curie temperature is exceeded.

SUPPORTED BY Robert A. Welch Foundation

8.0058, COLLISIONS INVOLVING ATOMS IN HIGH RYDBERG STATES

R.F. STEBBINGS, Rice University, Graduate School, *Houston, Texas* 77001 (PHY76-11453 A01)

This project is an investigation of the properties of atoms in high Rydberg states. Tunable lasers are used to excite xenon atoms to a single well-defined highly excited state with principal quantum number n in the range 25 is less than or equal to n is less than or equal to 41. The lifetimes of xenon atoms in these states have been determined together with their response to external electric fields. The collisional ionization of xenon atoms has also been investigated in thermal encounters with various molecules. The major thrust of the present proposal is the extension of the scope of these measurements to other species such as Ne, Ar, Kr, and the extension of the scope of the measurements for a given species.

This work is a continuation of that currently supported by Foundation grant MPS74-11690A02.

SUPPORTED BY U.S. National Science Foundation, Div. of Physics

8.0059, CHEMIIONIZATION IN COLLISIONS INVOLVING EXCITED RARE GAS ATOMS

R.F. STEBBINGS, Rice University, School of Engineering, *Houston, Texas* 77001 (C-552)

A beam containing xenon atoms in a single high Rydberg state (nf greater than 24 less than or equal to n less than or equal to 40) has been produced by laser photoexcitation. Absolute rate constants for the collisional ionization of these atoms have been measured by use of atomic beam techniques, for selected target molecules. In the case of polar targets the energy required to liberate the Rydberg electron may be provided by rotational deexcitation, e.g. Xe(nf greater than plus HCl(J) yields Xe ion plus Hcl(J' less than J) plus e.

Negative ion production has been observed during collisional ionization of Xe(nf greater than with electron attaching targets). In certain cases the negative ion species has been identified, e.g. Xe nf greater than plus CCl4 yields Xe ion plus CCl3 plus Cl anion.

The measured rate constants are typically very large (approximately 10 to the minus 7th power cm3 sec-1) and lend support to the theoretical model which views collisional ionization as being dominated by the interaction between the Rydberg electron and the target molecule, with the Xe ion core playing only a minor role. Further studies of the collisional ionization process are in progress.

A second apparatus has been completed in which beams containing alkali atoms in a single high Rydberg state may be produced. The higher fluxes of excited atoms obtainable in this apparatus will permit the study of a wider range of collisional processes.

SUPPORTED BY Robert A. Welch Foundation

8.0060, TRANSVERSE-ULTRASONIC-ATTENUATION STUDIED IN SUPERCONDUCTING ZINC AND MOLYBDENUM

B.J. MARSHALL, Texas Technological University, School of Arts & Sciences, *Lubbock, Texas* 79409 (D-170)

Transverse-ultrasonic-attenuation measurements are being conducted on high-purity single crystals of both zinc and molybdenum in the normal and superconducting states. The waves are being propagated in the (0001), (1010) and (1120) directions for several different polarizations. Since the Fermi surfaces of these crystals are very complex one would anticipate a large anisotropy in the superconducting energy gaps and perhaps even multiple energy gaps. Our earlier studies on these crystals using longitudinal sound waves indicated anisotropy and possibly multiple gaps. However, longitudinal waves average the energy gap over a wide segment of the Fermi surface and will not give a detailed picture of a selected portion of it. The transverse waves with several possible polarizations allow us to be considerably more selective regarding the portion of the Fermi surface that we wish to investigate.

The frequencies being utilized in this study vary from 10 to 100 MHz and the mean free path for the electrons are such as to give a wide range of ql values on both sides of unity (i.e., ql approximately greater than 1, ql approximately less than 1).

SUPPORTED BY Robert A. Welch Foundation

8.0061, ELECTRON CAPTURE INTO THE 3D AND 3P STATES OF ATOMIC HYDROGEN

H.R. DAWSON, Angelo State University, Undergraduate School, *San Angelo, Texas* 76901 (AJ-497)

The absolute cross sections for the transfer of electrons into the 3d, 3p, and 3s states of atomic hydrogen due to proton and deuteron impact on carbon dioxide gas have been measured over the energy range from 22 to 8.2 keV. All three cross sections appear essentially constant over this energy range. The cross section for 3p capture is greater than that for 3d capture, while both exceed the cross section for 3s capture by an order of magnitude. The relative sizes of these cross sections agree well with those for diatomic gas targets measured in this laboratory.

SUPPORTED BY Robert A. Welch Foundation

8.0062, LOCALIZED AND COLLECTIVE EXCITATION AND ORDERING PROCESSES IN IONIC CRYSTALS
F. LUTY, Utah Higher Education System, School of Letters & Science, *Salt Lake City, Utah* 84112 (DMR77-12675)

Research previously supported by DMR74-13870.

The investigations will cover a variety of systems with the purpose of establishing interconnections between localized defect and collective crystal behavior. (1) Molecular and off-center paraelectric defects will be investigated. Particular emphasis will be on studies of these systems under hydrostatic pressure. The close similarities of the pressure-induced transitions to the behavior of displacive ferroelectrics will be explored. (2) Mixed alkali-halide-cyanide crystals of the type KBr1-x(CN)x will be studied by means of Raman, optical and dielectric techniques. (3) Resonance Raman scattering and hot luminescence effects of F-center defects will be carried out. The systems to be studied will include hydrogen defects in alkali-halides. The motivation of this work, besides the fundamental interest in the interrelation of the resonance scattering process-will be the potential of these systems for broadly tunable IR laser application.

SUPPORTED BY U.S. National Science Foundation, Div. of Materials Research

8.0063, ACQUISITION OF EQUIPMENT FOR HIGH-ENERGY PHYSICS RESEARCH
L.W. MO, Virginia Poly. Inst. & St. U., Graduate School, *Blacksburg, Virginia* 24061 (PHY76-23478 A02)

This research is a two-part program and is being conducted at the Fermilab.

A study will be made of deep inelastic scattering of 200 GeV mu mesons from hydrogen and deuterium in a collaborative experiment with groups from Oxford University, University of Chicago, and Harvard University. The experiments will give results bearing on questions of scaling, structure functions and parton composition of the nucleon.

A measurement of nu micron-electron scattering cross sections in the few-hundred-GeV range will be made in a collaborative experiment with Oxford University. The experiment will give fundamental information on the properties of the weak interactions and particularly weak neutral currents.

This work represents a continuation of that currently supported by Foundation grant PHY76-23478.

SUPPORTED BY U.S. National Science Foundation, Div. of Physics

8.0064, THEORETICAL STUDIES IN DISORDERED AND MANY-BODY SYSTEMS
E.N. ECONOMOU, Univ. of Virginia, School of Arts & Sciences, *Charlottesville, Virginia* 22903 (DMR76-19458 A01)

Theoretical studies of the electronic properties of disordered and many-body electronic solid-state systems which were previously supported by NSF grant DMR-7619458 will be continued. The technique for treating many-body systems through the use of a self-consistent, random, one-particle potential which was previously developed by the investigator will be extended and applied to interesting solid-state systems such as impurity bands in crystalline semiconductors, the order-disorder transition in nickel sulphide and quasi-one-dimensional organic conductors. Additional topics which will be investigated include photo-structural transformations in amorphous semiconductors and super-conductivity in the palladium hydrides.

SUPPORTED BY U.S. National Science Foundation, Div. of Materials Research

8.0065, SPECTROSCOPY OF MAGNETICALLY ORDERED MATERIALS
W.M. YEN, Univ. of Wisconsin, School of Letters & Science, *Madison, Wisconsin* 53706 (DMR76-21574)

Recently developed laser spectroscopic techniques will be applied to the optically active ions which possess magnetic properties. Emphasis will be put on the study of the dynamics of optically excited states. The proposal is divided into complementary areas: (1) studies of static magnetooptical properties of ordered systems using ultra-high-sensitivity modulation techniques, (2) continued studies of fluorescence line narrowing and saturation spectroscopy properties of magnetic ions as dopants and as constituents of crystalline solids, and (3) initiation of experiments utilizing tunable dye lasers to probe into coherence properties of magnetically ordered states.

This is a continuation of research supported under DMR73-02478 AO1.

SUPPORTED BY U.S. National Science Foundation, Div. of Materials Research

SPACE SCIENCES

Includes Space Sciences (general); Astronomy; Astrophysics; Lunar and Planetary Exploration; Solar Physics; and Space Radiation. For Related Information See Also Geosciences.

10.0001, A THEORETICAL STUDY OF THE SUBSTORM PROCESSES
J.R. KAN, Univ. of Alaska, Geophysical Institute, *Fairbanks, Alaska* 99701 (ATM77-11371)

This grant continues Dr. Kan's theoretical study of magnetospheric substorm processes during the next 12 months. Attention will be focussed on the following three problem areas: (a) Can a substorm be triggered by a suitable disruption of the cross-tail current? The objective of this project is to determine the substorm triggering mechanism. (b) Conductivity of a collisionless plasma in an X-type reconnection configuration. The objective of this project is to improve our understanding of the reconnection process in a collisionless plasma. (c) Magnetopause current in the presence of a normal component of the magnetic field. The objective of this project is to understand how the energy is transferred from the solar wind through the open magnetopause into the magnetotail. The main emphasis is to identify and to understand the triggering mechanism for the onset of a magnetospheric substorm.

SUPPORTED BY U.S. National Science Foundation, Div. of Atmospheric Sciences

10.0002, SOLAR AND PLANETARY VARIATIONS
G.W. LOCKWOOD, Lowell Observatory, *Flagstaff, Arizona* 86001 (ATM76-17405 A01)

Titan, largest satellite of Saturn (and the only solar system satellite known to have an atmosphere), Uranus, and Neptune, were observed photoelectrically in the blue and yellow spectral regions at the Lowell Observatory in Flagstaff, Arizona, from 1971 to 1976. During this period, they brightened steadily at differing rates averaging nearly one percent per year. There is no satisfactory explanation for the brightening. All of the observations, made differentially with respect to nearby stars, were corrected for effects of changing distance of the earth and planets from the sun. The implications for the terrestrial radiation budget are profound if the earth's brightness, as seen from space, changes in a similar fashion. Alternately, it is possible that the solar energy output is changing which would also have interesting implications in terms of climatic change.

This grant continues planetary and satellite observations for two more years, from 1976 to 1978. During this time solar activity will rise from minimum to near maximum and it may be possible to establish a correlation between solar activity and planetary brightness changes. The same telescope, auxiliary equipment, and observational techniques will be used for the new observations, ensuring homogeneity of the measurements. New filters will be added for observations in the ultraviolet and red spectral regions. The planetary satellites Rhea (Saturn 5), Europa (Jupiter 2), and Callisto (Jupiter 4) will be added to the program. Unlike Titan,

Uranus and Neptune, these satellites have solid visible surfaces composed of ices and low-albedo minerals. The presence or absence of brightness changes in these satellites will help determine if previously observed changes are principally related to solar radiation itself, or represent changes in the albedos of planetary atmospheres caused in some way by the sun.

SUPPORTED BY U.S. National Science Foundation, Div. of Atmospheric Sciences

10.0003, A NEW MOUNTING FOR THE 1-METER TELESCOPE OF THE MOUNT LEMMON OBSERVATORY, UNIVERSITY OF ARIZONA
G.V. COYNE, Univ. of Arizona, School of Liberal Arts, *Tucson, Arizona* 85721 (AST76-22483 A01)

Accurate position encoders will be added to the 1-meter reflector of the Mt. Lemmon Observatory of the University of Arizona in order to be able to set the telescope accurately in right ascension and declination. The telescope was recently remounted in an English cross axis with funds from the National Science Foundation and it is now a very versatile telescope. Rapid accurate positioning will increase the efficiency of the telescope by at least a factor of two and will further relieve the scheduling pressure on the larger University of Arizona telescopes.

SUPPORTED BY U.S. National Science Foundation, Div. of Astronomical Sciences

10.0004, A DEEP NEAR-INFRARED PHOTOGRAPHIC SKY SURVEY AS A SUPPORT TOOL FOR THE INFRARED ASTRONOMICAL SATELLITE
E.R. CRAINE, Univ. of Arizona, Graduate School, *Tucson, Arizona* 85721 (NSG 7368)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

10.0005, SOLAR MAGNETIC FIELDS
S.P. WORDEN, Lockheed Missiles & Space Co., *Palo Alto, California* 94304 (DF248970; F19628-77-C-0128)

AF function - communications, surveillance, detection, tracking. Deficiency - inadequate warnings of sun-induced disruptions. Objective - determine the effect of motions and magnetic fields on the solar atmosphere and how each contributes to the environment for solar activity. How research contributes - provides the physical knowledge necessary for a sound cause-and-effect prediction technique for solar-induced disruptions.

Observations will be made to establish the size and strength of magnetic elements and to determine spatial correlations between the magnetic and velocity fields in the atmosphere.

ADDENDA: Supporting agency address is: AF Geophysics Laboratory PH Hanscom AFB, Bedford, Mass 01730

SUPPORTED BY U.S. Dept. of Defense, Air Force

10.0006, STUDIES IN STELLAR ASTRONOMY
J. GREENSTEIN, Calif. Inst. of Technology, Graduate School, *Pasadena, California* 91109 (AST77-09191)

The properties of intrinsically faint stars have been under study by the principal investigator for many years. A large amount of observational material is already available as a result of observing programs carried out on the 200-inch Hale reflector on Mt. Palomar. Statistical and astrophysical studies of these observations will be made in order to determine the spatial distribution and kinematics of these stars in our Galaxy and the solar neighborhood. Physical characteristics, such as temperatures and composition differences, will also be determined. This program will provide new data on low-mass stars which will be of use in studies of stellar and galactic evolution.

SUPPORTED BY U.S. National Science Foundation, Div. of Astronomical Sciences

10.0007, SOLAR AND ATMOSPHERIC NEUTRONS AND GAMMA-RAYS
R.S. WHITE, Univ. of California, School of Natural & Agric. Sc., *Riverside, California* 92502 (ATM77-08483)

This grant continues the search for solar neutrons of 2-100 MeV and gamma-rays of 0.5 to 30 MeV during solar flares and quiet times. Further support will continue the measurements of the earth's albedo neutron and gamma-ray fluxes. These observations will be carried out with the University of California, Riverside, neutron and gamma-ray double scattering telescope launched on a balloon from Muskogee, Oklahoma, in the spring of 1978. The UCR telescope has high sensitivity, good directionality, wide aperture, good energy resolution and excellent background rejection. The detector will be calibrated with gamma-rays produced by protons bombarding targets at the Van de Graaff accelerator at California State University, Los Angeles. Data analysis will continue on the 48-hour flight at Muskogee, Oklahoma, where the sun was observed during the two days May 23 and May 24, 1976. The data analysis will be carried out at UCR using the campus' 360-50 computer and tie-line to the Lawrence Berkeley Laboratory 6600 and 7600 computers. A possible gamma-ray flux of (1.1 plus 0.9) times 10 to the minus 3rd power gamma/cm2 sec from 3 to 30 MeV was seen from the quiet sun on May 13, 1975, using vertical pair events. Confirmation of the event will be sought by analysing new data from the May 23 and 24, 1976, flight.

SUPPORTED BY U.S. National Science Foundation, Div. of Atmospheric Sciences

10.0008, LATITUDINAL STRUCTURE OF SOLAR WIND STREAMS FROM RADIO SCINTILLATION OBSERVATIONS
B.J. RICKETT, Univ. of California, Graduate School, *San Diego, California* 92037 (DF248790; F19628-77-C-0161)

AF function - communications, surveillance, detection, tracking. Deficiency - inadequate means to determine conditions within solar-wind streams. Objective - to recognize from coronal radio and optical observations which high-latitude coronal structures can give rise to solar wind streams in the ecliptic. How research contributes - provides the observational tools necessary to predict conditions in the solar wind as it affects the terrestrial space environment.

Observe the solar wind speed in and out of the ecliptic by the method of interplanetary radio scintillations and compare these with geomagnetic and coronal optical observations. These data will then be compared with spacecraft-observed solar wind data to infer correlations among the various types of data.

ADDENDA: Supporting agency address is: AF Geophysics Laboratory PHS, Hanscom AFB, Bedford, Mass 01730

SUPPORTED BY U.S. Dept. of Defense, Air Force

10.0009, SPECTROSCOPIC STUDIES RELATING TO SEVERAL OUTSTANDING PROBLEMS IN STELLAR EVOLUTION THEORY AND EARLY GALACTIC CHEMICAL EVOLUTION
D. BUTLER, Yale University, Graduate School, *New Haven, Connecticut* 06520 (AST76-83413)

A new method of obtaining integrated spectra of globular clusters will be used in order to examine the question of mass loss in stars after they have evolved away from the main sequence. There will be a spectroscopic survey of individual stars in the globular cluster NGC 6397. The stars to be surveyed are near a stage where extensive mass loss may be taking place. A sample of RR Lyrae variable stars which are not within globular clusters will be studied in order to obtain information on the carbon, nitrogen and oxygen abundances in these stars. An analysis of the heavy element abundances in RR Lyrae stars in the globular cluster micron Centauri will be completed.

SUPPORTED BY U.S. National Science Foundation, Div. of Astronomical Sciences

10.0010, STUDIES OF WHITE-DWARF STARS
H.L. SHIPMAN, Univ. of Delaware, School of Arts & Sciences, *Newark, Delaware* 19711 (AST76-20723)

Theoretical studies on white dwarf stars and their atmospheric parameters--temperatures, masses, radii, and chemical compositions--will be made. In particular, both the hot and cool hydrogen-rich white dwarf stars will be studied. An investigation will be made of the soft X-ray and extreme ultraviolet fluxes from high-temperature white dwarfs. A grid of cool dwarf model atmospheres will be calculated. Computer techniques will be applied to the reduction of spectra measurements in order to see if any significant improvement is possible in the measurement of gravitational redshifts. A grid of helium-rich model atmospheres will be constructed for cool white dwarf stars. Other areas that will be examined include problems of white dwarf variables, and polarization studies in white dwarfs.

SUPPORTED BY U.S. National Science Foundation, Div. of Astronomical Sciences

10.0011, TRAVEL TO ATTEND CENTRE DE DONNEES STELLAIRES AND OBSERVATORY, STRASBOURG, FRANCE, JUNE 1-30, 1977
H.K. EICHHORN, State University of Fla. Sys., School of Natural Sciences, *Tampa, Florida* 33620 (AST77-20114)

At the invitation of the Center for Stellar Data and the Observatory, both at Strasbourg, France, Dr. Eichhorn will spend the month of June in Strasbourg to work with staff on the compilation of a comprehensive star catalog, from data existing there on tape. These data have been assembled by the Center for Stellar Data from contributions by astronomers worldwide. The new star catalog would be much more comprehensive and accurate than the Smithsonian Astrophysical Observatory Catalog published in 1966 under Dr. Eichhorn's direction. Such catalogs are used throughout astronomy for defining the positions of moving objects relative to the background of stars. The precision of such a position, or series of positions, thus depends on the accuracy of the catalog in both its freedom from systematic as well as accidental errors. Both effects will be considered in the compilation of the new catalog. Methods to make the catalog available to the astronomical community will be discussed.

SUPPORTED BY U.S. National Science Foundation, Div. of Astronomical Sciences

10.0012, DEFINITIVE CATALOG OF POSITIONS AND PROPER MOTIONS OF STARS BETWEEN DECLINATION 70 DEGREES S AND THE SOUTH POLE
H.K. EICHHORNVONWURM, State University of Fla. Sys., School of Natural Sciences, *Tampa, Florida* 33620 (AST76-20809)

In the plan to construct, over all the sky, an independent catalogue of star positions complete to the magnitude limit set by the Astronomische Gesselschaft, plates of the South Polar Cap were secured by Yale in 1955 and 1956, mostly by the late Dirk Brouwer as one of the last zones to be photographed. These plates were measured during the late sixties and a preliminary reduction of the measurements made, along with preliminary proper motions, derived from a variety of sources. In a continuation of work under a prior grant to Yale University, the definitive reduction will be done as originally planned, using the plate overlap method.

In addition, a near definitive new determination of plate constants for the Melbourne zone of the Astrographic Catalogue, which will immediately provide accurate positions for all stars whose measured coordinates constitute the Melbourne AC, would be a by-product of this work. New and more accurate proper motions of the program stars will be derived.

SUPPORTED BY U.S. National Science Foundation, Div. of Astronomical Sciences

10.0013, COMPREHENSIVE STUDY OF POSSIBLE SOLAR ACTIVITY INFLUENCE ON THE UPPER STRATOSPHERE AND MESOSPHERE
C.G. JUSTUS, Georgia Inst. of Technology, School of Engineering, *Atlanta, Georgia* 30332 (ATM77-05967)

This grant funds a study of possible influences of solar activity on the upper stratosphere and mesosphere (25-90 km). The indices of solar activity whose possible influences will be studied are: 1) the AE index, a measure of global electrojet activity, 2) the magnetic storm index Dst, 3) the solar radio noise flux at 10.7 cm wavelength F 10.7, 4) the 1000 A to 3500 A UV flux as measured by satellite, 5) the 1 A to 20 A X-ray flux as measured by satellite, 6) solar proton flux as measured by satellite, 7) solar magnetic sector boundary crossings, 8) solar magnetic sector intensities, 9) the Zurich sunspot number, and 10) and the satellite measured near-earth cosmic-ray flux (to investigate potential effects of solar magnetic field modulations on cosmic-ray flux and resultant influence on ionization). The meteorological parameters of the 25-90 km altitude region whose possible influence by solar activity is to be studied are: 1) departures of measured temperature, density, pressure, zonal wind, and meridional wind from 'climatological' monthly means, 2) the magnitude of gravity waves and planetary waves, as deduced by the daily difference analysis method, 3) weekly stratospheric circulation index and thickness values for the 30 degrees to 70 degrees latitude area between pressure heights to 5 mb and 0.4 mb.

SUPPORTED BY U.S. National Science Foundation, Div. of Atmospheric Sciences

10.0014, OBSERVATIONS OF THE PERSEUS CLUSTER WITH THE SAS-3 SATELLITE
M.P. ULMER, Northwestern University, Graduate School, *Evanston, Illinois* 60201 (NSG 5196)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

10.0015, SEARCH FOR AN X-RAY IDENTIFICATION OF A STRONG GAMMA-RAY SOURCE
R.C. LAMB, Iowa State Univ. of Sc. & Tech, School of Hum. & Sciences, *Ames, Iowa* 50010 (NSG 5199)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

10.0016, COSMIC-RAY SPECTRA AND THEIR COMPOSITION IN THE ATMOSPHERE FROM 0.1 TO 30 TEV AND STRONG INTERACTIONS AT VERY HIGH ENERGIES
G.B. YODH, Univ. of Maryland, School of Arts & Sciencès, *College Park, Maryland* 20742 (PHY77-01438)

An experiment is designed to measure the attenuation of primary cosmic-ray protons in the atmosphere to determine the interaction length of protons in air up to 20 TeV. The nucleon-nucleon cross section is subsequently derived. A balloon-borne detector will measure the primary cosmic-ray spectrum up to 50 TeV. A multi-element detector is to be built to measure charge multiplicities from interactions up to 100 TeV. Development of a transition radiation detector to measure the cosmic-ray flux of highly charged nuclei of relatively low velocity. This research is a continuation of that initiated under NSF Grant PHY76-14853.

SUPPORTED BY U.S. National Science Foundation, Div. of Physiology Cellular & Molecular Biology

10.0017, ASTRONOMY RESEARCH AT THE FIVE COLLEGE RADIO ASTRONOMY OBSERVATORY
G.R. HUGUENIN, Univ. of Massachusetts, School of Arts & Sciences, *Amherst, Massachusetts* 01002 (AST76-24610)

The Five College Radio Astronomy Observatory will pursue three major projects during the next three years; the very successful program of pulsar observation will be continued. The behavior of pulsars and their motion through space will be determined in an attempt to characterize the emission mechanism, the rate of formation and other attributes of these unusual, highly condense objects. The meter wave array used for these observations will be enlarged in order to improve the sensitivity and increase the number of observable objects. The 45-foot, radome-enclosed, millimeter telescope will be brought into full scientific operation. It will be used in conjunction with very sensitive maser receivers for studies of the interstellar medium, extragalactic radio sources, and solar system objects. Development will continue on the appli-

cation of very low noise maser amplifiers for radio astronomy at millimeter wavelengths. As such receivers become available, they will be put into use on the telescope where it is expected they will provide a ten- to fifty-fold increase in sensitivity.

SUPPORTED BY U.S. National Science Foundation, Div. of Astronomical Sciences

10.0018, RESEARCH ON INTEGRATED SILICON BOLOMETERS
UNKNOWN, Mass. Inst. of Technology, Graduate School, *Cambridge, Massachusetts* 02139 (NSG 7328)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

10.0019, INVESTIGATION OF THE DETAILED LIGHT CURVES USING SAS-3
T.A. MATILSKY, Rutgers The State University, Graduate School, *New Brunswick, New Jersey* 08903 (NSG 5195)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

10.0020, TWO-STATION METEOR PATROL FOR ORBIT DETERMINATION AND SPECTROSCOPY
H.A. BEEBE, New Mexico State University, School of Arts & Sciences, *Las Cruces, New Mexico* 88001 (NSG 7346)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

10.0021, EXPLOSIVE PHENOMENA IN SUPERNOVAE, QUASARS AND STELLAR FLARES
S.A. COLGATE, New Mexico Inst. Min. & Tech., Graduate School, *Socorro, New Mexico* 87801 (AST75-22918 A01)

A broad range of astrophysical problems, consisting of explosive phenomena in supernovae, quasars, and stellar flares, will be investigated. There will be a numerical modelling of the radiation flow in the expanding outer layers of a supernova in order to determine if the supernova explosion shocks will be made. Studies will be made on radiation mechanisms for quasars. It is believed that it will be possible to explain the observed radiation from these objects on the basis of a single self-consistent mechanism. There will be a theoretical study of the structure of solar flares. There will be continued development of a telescope to carry out a search for supernovae in other galaxies.

This is a renewal of NSF grant AST75-22918.

SUPPORTED BY U.S. National Science Foundation, Div. of Astronomical Sciences

10.0022, MULTICHANNEL SPECTROMETER OBSERVATIONS AND ANALYSIS OF DATA
K.W. FORD, New Mexico Inst. Min. & Tech., Res. & Development Division, *Socorro, New Mexico* 87801 (NCA 5-72)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

10.0023, RESEARCH IN COMETARY AND ASTROPHYSICAL SERVICES
E. MOORE, New Mexico Inst. Min. & Tech., Graduate School, *Socorro, New Mexico* 87801 (NCA 5-67)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

10.0024, COMETARY AND ASTROPHYSICAL RESEARCH ACTIVITIES
E. MOORE, New Mexico Inst. Min. & Tech., Graduate School, *Socorro, New Mexico* 87801 (NCA 5-71)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

10.0025, MICROWAVE ANALOGUE STUDIES OF LIGHT SCATTERING BY SMALL PARTICLES
D.W. SCHUERMAN, State University of New York, Graduate School, *Albany, New York* 12203 (NSG 7353)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

10.0026, THE CROSS PETROGLYPH - ITS ASTRONOMICAL IMPLICATIONS AND ROLE IN THE DESIGN OF MESOAMERICAN CEREMONIAL CENTERS
A.F. AVENI, Colgate University, Graduate School, *Hamilton, New York* 13346 (BNS77-07558)

Anthropologists have long speculated as to the extent of scientific and engineering knowledge among early civilizations in the New World. In particular, it has been suggested that there was a fairly sophisticated astronomy, and that ceremonial architecture was guided by an attempt to align structures so as to make accurate observations. This research will collect and analyze data on certain symbols which appear in several widely separated sites in Mexico and Guatemala in an effort to test certain hypotheses about the nature of early Mesoamerican civilization.

SUPPORTED BY U.S. National Science Foundation, Div. of Behavioral & Neural Sciences

10.0027, PREPARATION OF FINDING CHARTS FOR A CATALOG OF STARS WITH LARGE PROPER MOTIONS
H. ALBERS, Vassar College, Graduate School, *Poughkeepsie, New York* 12601 (AST77-14166)

Stars of large proper motion are almost always relatively close to the sun. A few stars at greater distances may show large proper motions due to their unusually rapid motion through space. Both kinds are of interest in determining the stellar population of the solar neighborhood. The fainter objects are stars of low luminosity, including red main sequence, subdwarf, and white dwarf stars. These furnish information about the faint end of the luminosity function near the sun.

A catalog of stars over the whole sky with proper motions greater than 0.5 seconds of arc per year has been compiled by Willem Luyten at the University of Minnesota from his extensive researches and all published sources. The catalog contains positions, magnitudes, colors, and motions for all the stars known at present to fall within this limit. It is planned to publish this catalog. Support by this award will permit finding charts to be made of all the stars so that they can be published together with the statistical data. It is planned to provide finding charts for all stars except those already in standard catalogs so that the published catalog will be of greater value to the observational astronomer. The charts will be done by the principal investigator, Dr. Henry Albers, at the University of Minnesota working in collaboration with Dr. Luyten.

SUPPORTED BY U.S. National Science Foundation, Div. of Astronomical Sciences

10.0028, OAO DATA ANALYSIS
J.L. HUTCHINSON, Vassar College, Graduate School, *Poughkeepsie, New York* 12601 (NSG 7359)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

10.0029, HIGH-RESOLUTION INFRARED SPECTROSCOPY OF INTERSTELLAR CLOUDS
B.L. LUTZ, State University of New York, Graduate School, *Stony Brook, New York* 11790 (AST76-04159 A01)

High-resolution studies of the visible and near-infrared spectra of moderately to heavily reddened early-type stars will be observed to study interstellar diatomic carbon (C2). A full observational program of the interstellar line spectrum of a star in Cygnus in which interstellar C2 has been identified will be carried out to study the interstellar chemistry in a dense optical cloud. This cloud is thought to be a transition state between the tenuous optical and dark radio clouds.

Additional observations of a star will be done to obtain a new upper limit of the C2 abundance to make a comparison with the cosmochemical models of Black and Dalgarno. Additional observations of the heavily reddened stars will be carried out to search for C2 in those regions.

The equipment to be used is the cassegrain echelle spectrography on the 60' reflector on Mt. Hopkins, Arizona, in conjunction with an image intensifier tube. Bright stars will be observed with PEPSIOS Fabry-Perot interferometer. The extension of the spectral data on the star in Cygnus will be carried out at Kitt Peak National Observatory with the Singer camera on the echelle spectrograph of the 4-meter telescope. A newly constructed cooled 3-stage image intensifier at Mt. Hopkins will also be used. Data reduction will be carried out at Stony Brook, New York, using the digitized Grant Microdensitometer interfaced with a computer.

This is a continuation of work previously supported by NSF grant AST76 04159.

SUPPORTED BY U.S. National Science Foundation, Div. of Astronomical Sciences

10.0030, STUDIES OF THE REGION OF THE SOLAR ATMOSPHERE MINIMUM BY INFRARED AND SUBMILLIMETER OBSERVATIONS
M. SIMON, State University of New York, School of Arts & Sciences, *Stony Brook, New York* 11790 (ATM77-13883)

Far-infrared (Wavelength approximately 30 micro micron) and submillimeter (lambda approximately 350 micron) solar continuum radiation arises near the region of the solar atmosphere temperature minimum. This is the region at which the energy is deposited that leads to the very high chromospheric and coronal temperatures found at higher atmospheric levels, and that ultimately drives the solar wind. Prof. Simon has been studying both the quiet and solar active aspects of this region by far-infrared and submillimeter techniques. With the support of NSF grant ATM72-01592 AO3 the following have been done: (1) Obtained mapping observations of several active regions in the several atmospheric windows between 350 micron and lmm. (2) Begun the nearly simultaneous observations of these regions in the near infrared to lambda approximately 30 micron. (3) Continued a program of measuring the brightness temperature profile across the sun at 350 micron and 450 micron to study the structure of the region of the temperature minimum and also to study the nature of certain brightness temperature fluctuations that are found on the quiet sun. (4) Improved a submillimeter detector system to facilitate these observations.

In the continuation of this work supported here concentration will take place in two areas: the simultaneous (and instrumentally co-axial) study of active regions in the submillimeter and far infrared, and (with the same instrument) the area of (3) above pertaining to the structure of the quiet sun. The goal of this work is to yield data that will contribute to our understanding of the mechanisms of energy deposition in the solar atmosphere, in quiet and active regions.

SUPPORTED BY U.S. National Science Foundation, Div. of Atmospheric Sciences

10.0031, HIGH-ENERGY GAMMA RADIATION AT ONE MILLIBAR
G.M. FRYE, Case Western Reserve Univ., Graduate School, *Cleveland, Ohio* 44106 (AST76-02578 A01)

A new large-area Multiple Wire Proportional Counter (MWPC) designed to observe gamma rays emitted from various celestial objects will be flown from Palestine, Texas, in the summer and fall of 1977. The region of the sky from the equator to 60 degrees north will be observed.

The new detector has an area of 8700 square centimeters and is the largest gamma-ray telescope in operation. The detector has an acceptance cone of 45 degrees, an effective solid angle of 1.1 ster 3 degrees angular resolution at 100 Mev, a 6 Mev threshold, and a timing accuracy of 10 to the minus 4th power sec UT. A seven-hour exposure to the Crab will collect about one thousand pulse gamma rays. A high-energy gamma-ray burst with a duration of one millionth of a second can be recorded.

Two main flights are planned in the middle of August and October. The Crab Nebula will be observed during the second flight and simultaneous optical observations are planned by other groups. A third balloon furnished by Australia will be used for a third flight to observe objects which need further observations or were unknown before the previous flights.

This is a continuation of work previously supported by NSF grant AST76 02578.

SUPPORTED BY U.S. National Science Foundation, Div. of Astronomical Sciences

10.0032, COORDINATED COPERNICUS AND GROUND-BASED OBSERVATIONS OF THE RADIO BINARIES
B.W. BOPP, Univ. of Toledo, School of Arts & Sciences, *Toledo, Ohio* 43606 (NSG 5207)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

10.0033, THE EFFECT OF PHOSPHORUS ON THE DEVELOPMENT OF THE STRUCTURE OF IRON METEORITES
J.I. GOLDSTEIN, Lehigh University, School of Engin. & Phys. Sci., *Bethlehem, Pennsylvania* 18015 (EAR74-22518 A01)

This project is a determination of the cooling rates of iron meteorites. Recent study of the system Fe-Ni-P has shown that phosphorus has a strong influence on the diffusion rates of iron and nickel in various mineral alloys and promotes the nucleation of Widmanstatten structures. Previous estimates of the cooling rates of iron meteorites have been based on experimental results in the phosphorus-free system and are thus significantly in error. The present study will be the simulation of growth of Fe-Ni (-P) minerals and the Widmanstatten pattern by computer methods. The computer simulation method is based on experimentally determined ternary diffusion coefficients and phase relationships. The computer program has been tested on a preliminary manner and found viable predicting experimental results. The cooling rates thus obtained will be used to interpret the mode(s) of formation of various types of iron meteorites and their parent asteroidal bodies.

SUPPORTED BY U.S. National Science Foundation, Div. of Earth Sciences

10.0034, COSMOLOGICAL INVESTIGATIONS AT MICROWAVE AND OPTICAL WAVELENGTHS
R.B. PARTRIDGE, Haverford College, Graduate School, *Haverford, Pennsylvania* 19041 (AST76-80201)

Observations will be carried out which may help to answer three important cosmological questions: What are the masses of clusters of galaxies (and the mean mass density of the Universe)? And finally, when do galaxies form, and what is their early evolution like?

A large part of the mass in and around clusters of galaxies may be in some form of intergalactic matter. Observations in the microwave region have set limits on the amount of ionized gas. Faint intergalactic starlight will be observed to determine the ratio of virial mass to luminosity for a number of galaxy clusters.

Observations will be carried out which will exploit the cosmological information contained in the angular variations in intensity of the cosmic microwave background radiation. Measurements of, or upper limits on, the isotropy and homogeneity of the Universe will be done making more sensitive measurements of the distribution of the cosmic microwave background on several angular scales.

A search for galaxies in the process of formation, at early epoch, and therefore large redshifts will be attempted.

SUPPORTED BY U.S. National Science Foundation, Div. of Astronomical Sciences

10.0035, BINARY STARS IN THE MILKY WAY AND LARGE MAGELLANIC CLOUD
R.H. KOCH, Univ. of Pennsylvania, Graduate School, *Philadelphia, Pennsylvania* 19101 (AST74-01656 A02)

Under an NSF grant to Robert Koch, research is carried out on 'Binary Stars in the Milky Way and the Large Magellanic Cloud.' A supplement to this grant will furnish salary support to a small college faculty astronomer to enable him to work with Koch at the Flower and Cook Observatory during the summer of 1977. A program of observation of the polarization in several wavelength regions of the light of five binary stars will be undertaken to gain further understanding of these systems. In addition, observational data obtained over several years for other binary systems will be analyzed. The results will be prepared for publication.

Prior support was by NSF grant AST74-01656 A01.

SUPPORTED BY U.S. National Science Foundation, Div. of Astronomical Sciences

10.0036, RADIATION PROBLEMS IN GENERAL RELATIVITY
A.I. JANIS, Univ. of Pittsburgh, School of Natural Sciences, *Pittsburgh, Pennsylvania* 15213 (PHY76-17253 A01)

Research in the general theory of relativity will include work on: 1) The geometric properties of the four-complex-dimensional space of shear-free null surfaces in asymptotically flat space-times. 2) Aspects of angular momentum in general relativity and work on stationary-axially symmetric space-times. 3) Scattering of electromagnetic radiation by gravitational fields. 4) Radiation in cosmological backgrounds.

This work represents a continuation of that currently supported by Foundation grant PHY74-18020 A01.

SUPPORTED BY U.S. National Science Foundation, Div. of Physics

10.0037, CONSTRUCTION OF AN ASTRONOMICAL POLARIMETER AT MCDONALD OBSERVATORY
M. BREGER, Univ. of Texas, School of Natural Sciences, *Austin, Texas* 78712 (AST76-22481)

A polarimeter will be constructed for use at the McDonald Observatory of the University of Texas. It will be a simple single-channel device using a rotating prism, and it will be fully compatible with the present photometric equipment at Texas.

The polarimeter will be used in: The determination of interstellar grain sizes in regions of star formation. The study of the wavelength dependence and time variability of polarization arising from circumstellar shells, measurement of the polarization of quasars and other radio emitting objects discovered in the Texas radio survey.

SUPPORTED BY U.S. National Science Foundation, Div. of Astronomical Sciences

10.0038, A BI-DIMENSIONAL, CENTER-OF-THE-DISK ANALYSIS OF RESIDUAL-INTENSITY FLUCTUATIONS IN A SOLAR SPECTRUM LINE
F.N. EDMONDS, Univ. of Texas, School of Natural Sciences, *Austin, Texas* 78712 (AST76-21384)

A bi-dimensional (wavelength-spatial) spectral analysis of residual-intensity fluctuations will be measured from high-dispersion, high-resolution, center-of-the-disk solar spectrograms of selected, strong, wiggly absorption lines. The spectral analysis will produce one- and bi-dimensional power, coherence and phase spectra of line-profile fluctuations. These results will provide information about the depth dependence of solar photospheric inhomogeneities and line formation in a nonhomogeneous photosphere with potential for satisfactory incorporation of inhomogeneities into solar photosphere studies, and the possible extrapolation of such studies to other stars.

SUPPORTED BY U.S. National Science Foundation, Div. of Astronomical Sciences

10.0039, A NEW SPECTROSCOPIC ORBIT FOR SPICO BASED ON COMPLETE PHASE COVERAGE WITHIN A SINGLE CYCLE
T.H. MORGAN, Houston Baptist University, School of Science & Hlth. Prof, *Houston, Texas* 77036 (NSG 5188)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

10.0040, THEORETICAL RESEARCH ON PLANETARY ATMOSPHERES
J.W. CHAMBERLAIN, Rice University, Graduate School, *Houston, Texas* 77001 (ATM74-02186 A02)

This grant funds the first year of a three-year continuing grant for a study of planetary atmospheres, with emphasis on the Earth's atmosphere. The research areas to be investigated are: 1. The physics and chemistry of the earth's stratosphere, with emphasis on alterations in the chemical and thermal balance of ozone and implications for climate change. 2. Planetary exospheres and atmospheric escape, with emphasis on the effects of charge-exchange collisions, as derived from solutions of the full Boltzmann equation. Attention will be focused on predictions of high-resolution profiles of Lyman-Alpha radiation, which should contain a large amount of information on the structure of a planet's exosphere. 3. Spectroscopic analysis of the atmospheres of the planets, with emphasis on radiative-transfer theory as applied to realistic models of atmospheric structure and chemistry. 4. Aeronomy of the ionosphere, including radiation polarization, the airglow, and aurora.

SUPPORTED BY U.S. National Science Foundation, Div. of Atmospheric Sciences

10.0041, RELATIONSHIP OF ISOTOPIC & CHEMICAL ANOMALIES IN METEORITES, EARTH, MOON & PLANETS TO ASTROPHYSICAL MODELS OF THEIR ORIGIN
D.D. CLAYTON, Rice University, Graduate School, *Houston, Texas* 77001 (NSG 7361)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

10.0042, INVESTIGATIONS OF X-RAY EMISSION FROM SUPERNOVA REMNANTS
P.F. WINKLER, Middlebury College, Graduate School, *Middlebury, Vermont* 05753 (NSG 5198)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

10.0043, ANALYSIS OF THE ULTRAVIOLET LINE PROFILES IN THE WOLF-RAYET STAR HD 50896
J.P. CASSINELLI, Univ. of Wisconsin, School of Letters & Science, *Madison, Wisconsin* 53706 (NSG 5180)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

GENERAL

11.0001, SETTLEMENT OF OUTER SPACE AND THE USE THEREOF FOR PERMANENT HABITATION (ABBREV)
R. FORRESTER, Univ. of California, School of Law, *San Francisco, California* 94102 (NCA 2-280701)

An investigation of selected legal questions engendered by NASA sponsored program concerning the settlement of outer space and the use thereof for permanent habitation.

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Organization & Management, Office of University Affairs

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01 AERONAUTICS (GENERAL)

N78-12000*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
THE 5TH MEETING OF THE AD HOC PANEL ON TERMINAL CONFIGURED VEHICLES
1977 206 p Meeting held at Hampton, Va., 14-15 Sep. 1977
(NASA-TM-78332) Avail: NTIS HC A10/MF A01 CSCL 02A

A report of the fifth meeting of the NASA Research and Technology Advisory Council, Ad Hoc panel on Terminal Configured Vehicles is presented. Some of the following topics were discussed: (1) microwave landing systems; (2) whole word computer system status; (3) flight path angle control; (4) VTOL approaches and landing technology; and (5) simulation study in wind shear. B.B.

N78-12001# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Systems and Logistics.
A STUDY OF OPPORTUNISTIC REPLACEMENT TACTICS FOR MODULAR JET ENGINE MANAGEMENT M.S. Thesis
Thomas J. Duvall and Thomas J. Goetz Jun. 1977 149 p refs
(AD-A044184; AFIT-LSSR-29-77A) Avail: NTIS HC A07/MF A01 CSCL 21/5

Opportunistic replacement for the F-100 engine has been previously studied to determine if an opportunistic replacement policy can save jet engine maintenance costs. The idea of opportunistic replacement is to replace an unfailed engine part before it fails while the engine is in the repair shop for some other reason (an opportunity). The costs that have been addressed in previous research are transportation, packing, manpower, parts, and depot overhaul costs. This study developed a method by which the impact of opportunistic replacement on spare engine and module inventory requirements can be assessed. Several different opportunistic replacement policies were studied and an optimum policy, based on the inventory costs and depot overhaul costs, was found. The optimum policy resulted in a 16 percent savings in initial inventory investment. Data was obtained from the Directorate of Propulsion and Auxiliary Power Systems, Headquarters, Air Force Logistics Command. Author (GRA)

02 AERODYNAMICS

Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces; and internal flow in ducts and turbomachinery.

For related information see also *34 Fluid Mechanics and Heat Transfer.*

N78-12002 Tennessee Univ., Knoxville.
ACOUSTIC SOURCE LOCATION IN A JET-BLOWN FLAP USING A CROSS-CORRELATION TECHNIQUE Ph.D. Thesis
Robert Stanley Becker 1977 177 p
Avail: Univ. Microfilms Order No. 77-16569

The acoustic source strength distribution in the turbulent flow field was measured for two far-field microphones at 45 deg above and below the plane of the flap surface by cross-correlating a processed signal from an inclined hot-film anemometry probe with the signal from the appropriate far-field microphone. An estimate of the contribution made by the sources associated with the fluctuating pressure on the flap surface to the sound received at a far-field microphone was made by cross-correlating the processed signals of microphones which were embedded in the flap surface with the far-field microphone signals. Fluid dynamic measurements were made in the flow field of the jet-flap using dual-sensor hot-film anemométry probes.
Dissert. Abstr.

N78-12003 Case Western Reserve Univ., Cleveland, Ohio.
INTERACTIVE CALCULATION PROCEDURE FOR SUPERSONIC FLOWS Ph.D. Thesis
Yehuda Tassa 1976 174 p
Avail: Univ. Microfilms Order No. 77-11916

An interactive procedure, developed for supersonic viscous flows and applicable for either two dimensional or axisymmetric configurations is described. The flow field is divided into two regions: (a) an inner region which is highly viscous and mostly subsonic, and (b) an outer region where the flow is supersonic and which viscous effects are small but not negligible. For the outer region a numerical solution is obtained by applying the method of characteristics to a system of equations which includes viscous and conduction transport terms only normal to the streamlines. The inner region is treated by a system of equations of the boundary layer type that includes higher order effects such as longitudinal and transverse curvature and normal pressure gradients. These equations are coupled and solved simultaneously in the physical coordinates using an implicit finite difference scheme.
Dissert. Abstr.

N78-12004 Tennessee Univ., Knoxville.
DOMINANCE OF RADIATED AERODYNAMIC NOISE ON BOUNDARY-LAYER TRANSITION IN SUPERSONIC-HYPERSONIC WIND TUNNELS: THEORY AND APPLICATION Ph.D. Thesis
Samuel Ralph Pate 1977 414 p
Avail: Univ. Microfilms Order No. 77-16594

Transition data measured in supersonic tunnels varying in test section heights from 1 to 16 ft demonstrated a significant and monatonic increase in transition Reynolds numbers with increasing tunnel size. The measured root-mean-square pressure fluctuations in the tunnel test section decrease with increasing tunnel size. A set of shroud experiments enabled the wall boundary layer to be directly controlled (either laminar or turbulent) and allowed transition Reynolds numbers to be correlated with the root-mean-square of the pressure fluctuations. Correlations of transition Reynolds numbers as a function of the radiated noise parameters were developed. A FORTRAN IV computer code using the aerodynamic-noise-transition correlations will accurately

predict transition locations on sharp flat plates and sharp slender cones. Dissert. Abstr.

N78-12005 California Univ., Los Angeles.
THE GENERAL SIMILARITY SOLUTION OF THE TRICOMI EQUATION WITH APPLICATIONS TO TRANSONIC FLOW Ph.D. Thesis
Chao-kang Feng 1977 138 p
Avail: Univ. Microfilms Order No. 77-16156

The method of group invariance under infinitesimal transformation is applied to the mixed elliptic and hyperbolic Tricomi equation which is useful in two-dimensional small disturbance transonic flow theory studied in the hodograph plane. A systematic approach for obtaining similarity solutions to the Tricomi equation is also found. The far field similarity solutions to the Tricomi equation relating to the high subsonic free stream singularity (still in the transonic range) are found for: (1) flow past a wavy wall; (2) flow past a lifting cascade; (3) flow past a symmetrical half-body; (4) flow past a symmetrical airfoil; and (5) flow past a lifting airfoil. By superimposing some new class of similarity solutions, the practical engineering problem for small disturbance transonic flow past a shock free lifting airfoil with parabolic nose is successfully constructed. Dissert. Abstr.

N78-12006 California Inst. of Tech., Pasadena.
SURFACE ROUGHNESS EFFECTS ON THE HYPERSONIC TURBULENT BOUNDARY LAYER Ph.D. Thesis
Dale Evan Berg 1977 209 p
Avail: Univ. Microfilms Order No. 77-17260

An experimental investigation of the response of a hypersonic turbulent boundary layer to a step change in surface roughness was performed. The boundary layer on a flat nozzle wall of a Mach 6 wind tunnel was subjected to abrupt changes in surface roughness and its adjustment to the new surface conditions was examined. Both mean and fluctuating flow properties were acquired for smooth-to-rough and rough-to-smooth surface configurations. The boundary layer was found to respond gradually and to attain new equilibrium profiles, for both the mean and the fluctuating properties. Mean flow self-similarity was the first to establish itself, followed by the mass flux fluctuations, followed in turn by the total temperature fluctuations. Dissert. Abstr.

N78-12007 Purdue Univ., Lafayette, Ind.
AN INVESTIGATION OF SHEAR TURBULENCE IN THE PRESENCE OF MAGNETIC FIELDS Ph.D. Thesis
Claude Brinton Reed 1976 224 p
Avail: Univ. Microfilms Order No. 77-15457

Turbulence measurements were made in a rectangular high aspect ratio channel in the presence of a transverse magnetic field. The aspect ratio of the channel was 5.8:1; its walls were electrically insulated. The working fluid was mercury and the geometry and experimental conditions were such that the experiment simulated turbulent Hartmann flow. Measurements were made of the skin friction coefficient, the mean velocity profiles, the turbulence intensity profiles (both u' and v') and the Reynolds stress profiles. The skin friction coefficient fell below the values predicted by Hartmann's laminar solution for high values of M/Re. Near the final transition from turbulent to laminar flow, the skin friction coefficient data exhibited a 'hump'. The mean velocity profiles displayed the well known Hartmann flattening effect. A semiempirical theory was constructed to predict the present data in a transverse magnetic field as well as that for pipe flow in an aligned field. Dissert. Abstr.

N78-12008 California Univ., Berkeley.
CROSS FLOW SEPARATION ON HIGHLY YAWED CONES IN A SUPERSONIC STREAM Ph.D. Thesis
Wang-Kit Chan 1976 76 p
Avail: Univ. Microfilms Order No. 77-15629

Supersonic flow past a cone at high angles of attack is investigated numerically. The angle of attack considered is high enough to ensure that a substantial portion of cross flow is supersonic. The numerical methods used are: (1) the Method of Lines for the inviscid windward region; (2) the Method of Characteristics for the inviscid shoulder region; and (3) a modified version of the Method of Integral Relations, for the viscous region. The viscous-inviscid interaction is taken into account by treating the outer edge of the displacement thickness as the effective inviscid boundary. Cross flow separation is observed in the leeward region of the cone once an embedded shock is introduced. Shock wave boundary layer interaction and its significance is discussed. Dissert. Abstr.

N78-12009# Aeronautical Research Labs., Melbourne (Australia).
CROSS FLOW DRAG DISTRIBUTIONS ON CONE-CYLINDER BODIES OF HIGH FINENESS RATIO AND VARIOUS NOSE ANGLES AT MACH 7.5
M. J. Williams and A. S. Kaye Apr. 1976 37 p refs
(ARL/Aero-Note-363) Copyright. Avail: Issuing Activity

The distribution of local normal force on the afterbodies of a series of cone cylinders have been measured at Mach 7.5. Nose semi-angles were 5 deg, 10 deg, 15 deg, 30 deg, 45 deg, 60 deg and the afterbody fineness ratio was 20 in each case. Data are presented for incidences up to 14 deg. Results show that both the initial derivative with respect to incidence of the local loading and the non-linear component of local loading are less than predicted by both theoretical and empirical methods. Use of high fineness ratio bodies has enabled estimation of asymptotic cross flow drag for a range of cross flow Mach numbers. No evidence was found of the transonic drag rise observed at lower Mach numbers. Author

N78-12010 Engineering Sciences Data Unit, London (England).
AERODYNAMIC CENTRE OF WING-FUSELAGE-NACELLE COMBINATIONS: EFFECT OF WING-PYLON MOUNTED NACELLES
Jun. 1977 9 p
(ESDU-77012; ISBN-0-85679-183-0) For information on availability of series, sub-series and other individual data items, write NTIS, Attn: ESDU, Springfield, Va. 22161. HC $146.50

The forward shift in aerodynamic center caused by mounting nacelles on pylons below the wings of wing fuselage combinations of medium to high aspect ratio is calculated. Calculations were done for subsonic speeds by treating the nacelles as annular aerofoils located in the wing upwash field. This shift is subtracted from the wing fuselage aerodynamic center position to provide the location of the overall aerodynamic center of the wing-fuselage-nacelle combination at cruise conditions. ESDU

N78-12011*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
STATIC AERODYNAMIC CHARACTERISTICS OF A 0.035-SCALE MODEL OF A MODIFIED NKC-135 AIRPLANE AT A MACH NUMBER OF 0.28
Ernest Hedstrom and W. Morrow Whitcomb (ARO, Inc., Moffett Field, Calif.) Sep. 1977 119 p refs
(NASA-TM-73250; A-7068) Avail: NTIS HC A06/MF A01 CSCL 01A

A 0.035-scale model fo a modified NKC-135 airplane was tested in 12-foot pressure wind tunnel to determine the effects on the static aerodynamic characteristics of modifications to the basic aircraft. Modifications investigated included: nose, lower fuselage, and upper fuselage radomes; wing pylons and pods; overwing probe; and air conditioning inlets. The investigation was performed at a Mach number of 0.28 over a Reynolds number range from 6.6 to 26.2 million per meter. Angles of attack and sideslip varied from -8 deg to 20 deg and from -18 deg to 8 deg, respectively, for various combinations of flap, aileron, and rudder deflections. A limited analysis of the test results indicates that the addition of the radomes reduces lateral-directional stability and control effectiveness of the basic aircraft. Author

N78-12012*# National Aeronautics and Space Administration, Washington, D. C.
FLUTTER ANALYSIS OF A GLIDER MADE OF SYNTHETIC MATERIALS
P. C. Hensing Oct. 1977 38 p refs Transl. into ENGLISH from Flutteranalyse van een Kunststof Zweefuliegtuig (Delft), UTH-187, Sep. 1974 35 p Translation was announced as N76-19148 Translated by Kanner (Leo) Associates, Redwood City, Calif. Original document prep. by Technische Hogeschool, Delft (Netherlands)
(Contract NASw-2790)
(NASA-TM-75160) Avail: NTIS HC A03/MF A01 CSCL 01A

A description of the flutter behavior of the Standard Cirrus is given. Steady vibration tests were conducted, and vibration and flutter calculations were made. Author

N78-12013*# Boeing Commercial Airplane Co., Seattle, Wash.
A USER'S GUIDE FOR V174, A PROGRAM USING A FINITE DIFFERENCE METHOD TO ANALYZE TRANSONIC FLOW OVER OSCILLATING WINGS Final Report
T. D. Butler, W. H. Weatherill, J. D. SeBastian, and F. E. Ehlers Dec. 1977 98 p refs
(Contract NAS1-14204)
(NASA-CR-145214) Avail: NTIS HC A05/MF A01 CSCL 01A

The design and usage of a pilot program using a finite difference method for calculating the pressure distributions over harmonically oscillating wings in transonic flow are discussed. The procedure used is based on separating the velocity potential into steady and unsteady parts and linearizing the resulting unsteady differential equation for small disturbances. The steady velocity potential which must be obtained from some other program, is required for input. The unsteady differential equation is linear, complex in form with spatially varying coefficients. Because sinusoidal motion is assumed, time is not a variable. The numerical solution is obtained through a finite difference formulation and a line relaxation solution method. Author

N78-12014*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
A TECHNIQUE FOR SIMULATING TURBULENCE FOR AEROSPACE VEHICLE FLIGHT SIMULATION STUDIES
George H. Fichtl Nov. 1977 22 p refs
(NASA-TM-78141) Avail: NTIS HC A02/MF A01 CSCL 01A

An atmospheric turbulence model which accommodates variability of turbulence properties along an aerospace vehicle trajectory was developed. The technique involves the use of Dryden spectral forms in which the defining parameters are the standard deviations (sigma) and integral scales (L) of turbulence. These spectra are expressed as nondimensional functions of the nondimensional frequency Omega = omega L/V where omega is dimensional radian frequency and V is the true air speed of the aerospace vehicle. The nondimensional spectra are factored by standard techniques to obtain nondimensional linear recursive filters in the time domain whereby band-limited white-like noise can be operated upon to obtain nondimensional longitudinal, lateral, and vertical turbulence velocities, as functions of nondimensional time, tV/L, where t is time. Application of the technique to the simulation of the space shuttle orbiter entry flight phase is discussed. Author

N78-12015*# Cincinnati Univ., Ohio. Dept. of Aerospace Engineering and Applied Mechanics.
SUPERSONIC SEPARATED TURBULENT BOUNDARY - LAYER OVER A WAVY WALL
A. Polak and M. J. Werle Nov. 1977 66 p refs
(Grant NsG-1208)
(NASA-CR-155329; AFL-77-11-36) Avail: NTIS HC A04/MF A01 CSCL 01A

A prediction method is developed for calculating distributions of surface heating rates, pressure and skin friction over a wavy wall in a two-dimensional supersonic flow. Of particular interest is the flow of thick turbulent boundary layers. The surface geometry and the flow conditions considered are such that there exists a strong interaction between the viscous and inviscid flow. First, using the interacting turbulent boundary layer equations, the problem is formulated in physical coordinates and then a reformulation of the governing equations in terms of Levy-Lees variables is given. Next, a numerical scheme for solving interacting boundary layer equations is adapted. A number of modifications which led to the improvement of the numerical algorithm are discussed. Finally, results are presented for flow over a train of up to six waves at various flow conditions. Author

N78-12016*# Cincinnati Univ., Ohio. Dept. of Aerospace Engineering and Applied Mechanics.
THE SEPARATED TURBULENT BOUNDARY LAYER OVER A WAVY WALL Final Report, 1 Jul. 1975 - 30 Sep. 1977
A. Polak and M. J. Werle 1977 21 p refs
(Grant NsG-1208; Contract F33615-76-C-3091)
(NASA-CR-155281) Avail: NTIS HC A02/MF A01 CSCL 01A

A study and application of the fourth order spline collocation procedure, numerical solution of boundary layer like differential equations, is presented. A simple inversion algorithm for the simultaneous solution of the resulting difference equations is given. Particular attention is focused on the boundary condition representation for the spline second derivative approximations. Solutions using the spline procedure, as well as the three point finite difference method, are presented for several model problems in order to assess and improve the spline numerical scheme. Application of the resulting algorithm to the incompressible laminar self similar boundary layer equations is presented. Author

N78-12017*# National Aeronautics and Space Administration, Washington, D. C.
WAKE VORTEX MINIMIZATION
1977 403 p Symp. held at Washington, 25-26 Feb. 1976
(NASA-SP-409) Avail: NTIS HC A18/MF A01 CSCL 01A

A status report is presented on research directed at reducing the vortex disturbances of aircraft wakes. The objective of such a reduction is to minimize the hazard to smaller aircraft that might encounter these wakes. Inviscid modeling was used to study trailing vortices and viscous effects were investigated. Laser velocimeters were utilized in the measurement of aircraft wakes. Flight and wind tunnel tests were performed on scale and full model scale aircraft of various design. Parameters investigated included the effect of wing span, wing flaps, spoilers, splines and engine thrust on vortex attenuation. Results indicate that vortices may be alleviated through aerodynamic means. For individual titles, see N78-12018 through N78-12028.

N78-12018*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
INVISCID MODELING OF AIRCRAFT TRAILING VORTICE
Vernon J. Rossow *In its* Wake Vortex Minimization 1977 p 9-60 refs (For availability see N78-12017 03-02)
Avail: NTIS HC A18/MF A01 CSCL 01A

A survey is presented of inviscid theoretical methods that are useful in the study of lift-generated vortices. Concepts derived using these invisicid theories are cited which have helped to guide research directed at alleviating the velocities and rolling moments imposed on aircraft entering these wakes. Author

N78-12019*# Aeronautical Research Associates of Princeton, Inc., N. J.
VISCOUS EFFECTS IN AIRCRAFT TRAILING VORTICES
Alan J. Bilanin, Milton E. Teske, Coleman Donaldson, and Richard S. Snedeker *In* NASA, Washington Wake Vortex Minimization 1977 p 61-128 refs (For availability see N78-12017 03-02)
(Contracts NAS1-13932; F44620-75-C-0051)
Avail: NTIS HC A18/MF A01 CSCL 01A

The mechanism of merging of like-signed aircraft vortices leading to a rapid redistribution of trailed vorticity in a wake through both convective and turbulent processes was investigated. Research was done experimentally in a small wind tunnel and analytically through the use of a code which computes turbulent transport using a second-order closure turbulent model. Computations are reported which demonstrate the merging phenomenon, and comparisons are made with experimental results. The usefulness of point vortex computations in predicting merging was explored. Limited computations showed that jet exhaust does not appreciably alter the merging phenomenon. The effect of ambient atmospheric turbulence on the aging of an aircraft wake was investigated at a constant turbulent dissipation rate. It was shown that under stable atmospheric conditions, when atmospheric macroscales are less than or equal to the vortex spacing, misleading results may be obtained. Author

N78-12020*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
GROUND-BASED FACILITIES FOR EVALUATING VORTEX MINIMIZATION CONCEPTS
Joseph W. Stickle and Mark W. Kelly *In its* Wake Vortex Minimization 1977 p 129-156 refs (For availability see N78-12017 03-02)
Avail: NTIS HC A18/MF A01 CSCL 01A

To determine the feasibility of altering the formation and decay of aircraft trailing vortexes through aerodynamic means, the test capabilities of two wind tunnels and two towing basins were used. The facilities, common models, and measurement techniques that were employed in the evaluation of vortex minimization concepts are described. Author

N78-12021*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
APPLICATION OF LASER VELOCIMETRY TO AIRCRAFT WAKE-VORTEX MEASUREMENTS
Donald L. Ciffone and Kenneth L. Orloff *In its* Wake Vortex Minimization 1977 p 157-192 refs (For availability see N78-12017 03-02)
Avail: NTIS HC A18/MF A01 CSCL 01A

The theory and use of a laser velocimeter that makes simultaneous measurements of vertical and longitudinal velocities while rapidly scanning a flow field laterally are described, and its direct application to trailing wake-vortex research is discussed. Pertinent measurements of aircraft wake-vortex velocity distributions obtained in a wind tunnel and water towing tank are presented. The utility of the velocimeter to quantitatively assess differences in wake velocity distributions due to wake dissipating devices and span loading changes on the wake-generating model is also demonstrated. Author

N78-12022*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
FLIGHT TEST TECHNIQUES FOR WAKE-VORTEX MINIMIZATION STUDIES
Robert A. Jacobsen and M. R. Barber *In its* Wake Vortex Minimization 1977 p 193-220 refs (For availability see N78-12017 03-02)
Avail: NTIS HC A18/MF A01 CSCL 01A

Flight test techniques developed for use in a study of wake turbulence and used recently in flight studies of wake minimization methods are discussed. Flow visualization was developed as a technique for qualitatively assessing minimization methods and is required in flight test procedures for making quantitative measurements. The quantitative techniques are the measurement of the upset dynamics of an aircraft encountering the wake and the measurement of the wake velocity profiles. Descriptions of the instrumentation and the data reduction and correlation methods are given. Author

N78-12023*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
UNSUCCESSFUL CONCEPTS FOR AIRCRAFT WAKE VORTEX MINIMIZATION
R. Earl Dunham, Jr. *In its* Wake Vortex Minimization 1977 p 221-250 refs (For availability see N78-12017 03-02)
Avail: NTIS HC A18/MF A01 CSCL 01A

Exploratory concepts are described which were investigated to achieve a reduction in the vortex induced rolling upsets produced by heavy aircraft trailing vortexes. The initial tests included the use of mass injection, oscillating devices, wingtip shape design, interacting multiple vortexes, and end plates. Although later refinements of some of these concepts were successful, initial test results did not indicate a capability of these concepts to significantly alter the vortex induced rolling upset on a following aircraft. Author

N78-12024*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
THRUST-AUGMENTED VORTEX ATTENUATION
James C. Patterson, Jr. and Frank L. Jordan, Jr. *In its* Wake Vortex Minimization 1977 p 251-270 refs (For availability see N78-12017 03-02)
Avail: NTIS HC A18/MF A01 CSCL 01A

An experimental investigation was conducted to determine the vortex attenuating effect of engine thrust. Tests were made using a 0.03-scale model of the Boeing 747 transport aircraft as a vortex generating model. A Learjet-class probe model was used to measure the vortex induced rolling moment at a scale separation distance of 1.63 km. These tests were conducted at a lift coefficient of 1.4 at a model velocity of 30.48 m/s. The data presented indicate that engine thrust is effective as a vortex attenuating device when the engines are operated at high thrust levels and are positioned to direct the high energy engine wake into the core of the vortex. The greatest thrust vortex attenuation was obtained by operating the inboard engine thrust reversers at one-quarter thrust and the outboard engines at maximum forward thrust. Author

N78-12025*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
GROUND DEVELOPMENT AND FLIGHT CORRELATION OF THE VORTEX ATTENUATING SPLINE DEVICE
James C. Patterson, Jr., Earl C. Hastings, Jr., and Frank L. Jordan, Jr. *In its* Wake Vortex Minimization 1977 p 271-303 refs (For availability see N78-12017 03-02)
Avail: NTIS HC A18/MF A01 CSCL 01A

Data presented indicate that the wing-mounted spline is an effective vortex-attenuating device. A comparison of the vortex induced rolling moment results at a separation scale distance of 0.70 km with those measured in full scale flight indicates good agreement for the unattenuated vortex configuration. The comparison also indicates that the spline effectiveness in flight was greater than in the ground facility test. The results of an applications study show that, for the heavy commercial jet aircraft studied, use of the splines does result in some degradation of the climb gradient and rate of climb, but the aircraft should meet certification requirements. Author

N78-12026*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
AIRCRAFT WAKE-VORTEX MINIMIZATION BY USE OF FLAPS
Victor R. Corsiglia and R. Earl Dunham, Jr. *In its* Wake Vortex Minimization 1977 p 305-338 refs (For availability see N78-12017 03-02)
Avail: NTIS HC A18/MF A01 CSCL 01A

A survey was made of research on the alleviation of the trailing vortex hazard by altering span loading with flaps on the generator airplane. Flap configurations of the generator that shed multiple vortices were found to have wakes that dispersed by vortex merging and sinusoidal instability. Reductions of approximately 50 percent in both the wake rolling moment imposed on a following aircraft and the aircraft separation requirement were achieved in the ground based and flight test experiments by deflecting the trailing edge flaps more inboard than outboard. Significantly, this configuration did not increase the drag or vibration on the generating aircraft compared to the conventional landing configuration. Ground based results of rolling moment measurement and flow visualization are shown, using a water tow facility, an air tow facility, and a wind tunnel. Flight test results are also shown, using a full scale B-747 airplane. General agreement was found among the results of the various ground based facilities and the flight tests. Author

N78-12027*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
THE DEVELOPMENT AND USE OF SPOILERS AS VORTEX ATTENUATORS
Delwin R. Croom *In its* Wake Vortex Minimization 1977 p 339-368 refs (For availability see N78-12017 03-02)
Avail: NTIS HC A18/MF A01 CSCL 01A

Results are presented of groundbased and flight investigations performed to develop spoilers as trailing vortex alleviation devices. Based on the results obtained in these investigations, it was found that the induced rolling moment on a trailing model can be reduced by spoilers located near the midsemispan of a vortex generating wing. Substantial reductions in induced rolling moment occur when the spoiler vortex attenuator is located well forward on both unswept and swept wing models. In addition, it was found that existing flight spoilers on the jumbo-jet transport aircraft can be effective as trailing vortex attenuators. Author

N78-12028*# National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Center, Edwards, Calif.
VORTEX ATTENUATION FLIGHT EXPERIMENTS
Marvin R. Barber, Earl C. Hastings, Jr., Robert A. Champine, and Joseph J. Tymczyszyn (FAA) *In its* Wake Vortex Minimization 1977 p 369-403 refs (For availability see N78-12017 03-02)
Avail: NTIS HC A18/MF A01 CSCL 01A

Flight tests evaluating the effects of altered span loading,

turbulence ingestion, combinations of mass and turbulence ingestion, and combinations of altered span loading turbulance ingestion on trailed wake vortex attenuation were conducted. Span loadings were altered in flight by varying the deflections of the inboard and outboard flaps on a B-747 aircraft. Turbulence ingestion was achieved in flight by mounting splines on a C-54G aircraft. Mass and turbulence ingestion was achieved in flight by varying the thrust on the B-747 aircraft. Combinations of altered span loading and turbulence ingestion were achieved in flight by installing a spoiler on a CV-990 aircraft and by deflecting the existing spoilers on a B-747 aircraft. The characteristics of the attenuated and unattenuated vortexes were determined by probing them with smaller aircraft. Acceptable separation distances for encounters with the attenuated and unattenuated vortexes are presented. Author

N78-12029# Toronto Univ. (Ontario).
ANALYSIS OF A LOOP TYPE FLEXIBLE SKIRT AIR CUSHION
P. A. Sullivan and G. J. Parravano Jun. 1977 23 p refs
(UTIAS-TN-204; ISSN-0082-5263) Avail: NTIS HC A02/MF A01

A theory is proposed for the loop or bag type flexible skirted air cushion or air bearing. It is shown that the nozzle formed by the skirt in the region where the air escapes from the cushion plays an essential role in the skirt action. Some numerical results are obtained for the case where the skirt behaves as a membrane and the flow in the nozzle can be considered inviscid and one-dimensional. The stiffness curves are compared with the corresponding curves for a simple rigid walled chamber fed from the same source. These show that the skirt can be relatively stiff in heave, but also that if very low mass flow rates are practical it will be much less stiff than the simple plenum chamber. Author

N78-12030# Toronto Univ. (Ontario). Inst. for Aerospace Studies.
DUCT EFFECTS ON THE DYNAMIC FAN CHARACTERISTICS OF AIR CUSHION SYSTEMS
M. J. Hinchey and P. A. Sullivan Jun. 1977 49 p refs
(UTIAS-TN-211; CN-ISSN-0082-5263) Avail: NTIS HC A03/MF A01

During dynamic operation of an air cushion system, the fan operating point as seen at the cushion does not move along a static characteristic. Instead, it moves on a loop. It is shown that loop type behavior can be predicted theoretically. The theory models the fan-duct-plenum system as a one dimensional acoustic vibration system. It uses the method of characteristics and a finite difference technique known as the method of specified time intervals to solve for the pressure and flow variations which occur along the duct during unsteady operation. Several practical situations where the loop behaviour may be of importance are discussed. Author

N78-12031*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
SUPERSONIC LONGITUDINAL AERODYNAMIC CHARACTERISTICS OF TWO SPACE SHUTTLE ORBITER CONFIGURATIONS
James C. Ellison Nov. 1977 32 p refs
(NASA-TM-74074; L-11787) Avail: NTIS HC A03/MF A01 CSCL 01A

An investigation was conducted to determine the supersonic longitudinal aerodynamic characteristics of 0.015 scale models of the Rockwell International 089B and 139B space shuttle orbiter configurations and the 139B orbiter with a modifier forebody. The models each had a 45 deg swept delta wing that was blended into the body with an 81 deg swept fillet to form a double delta planform. The vertical tail had a split rudder deflected 27.5 deg on each side to form a speed brake. Tests were conducted at Mach numbers of 2.5, 3.9, and 4.6 at a Reynolds number, based on the body length of the 089B model, of 4,150,000. Angles of attack varied from -4 deg to 44 deg at 0 deg sideslip. Author

N78-12032*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
LONGITUDINAL AERODYNAMIC CHARACTERISTICS AT MACH NUMBERS FROM 1.60 TO 2.86 FOR A FIXED-SPAN MISSILE WITH THREE WING PLANFORMS
M. Leroy Spearman and Wallace W. Sawyer Nov. 1977 26 p refs
(NASA-TM-74088; L-11916) Avail: NTIS HC A03/MF A01 CSCL 01A

Effects of wing planform modifications on the longitudinal aerodynamic characteristics of a fixed span, maneuverable cruciform missile configuration were determined. A basic delta planform and two alternate trapezoidal planforms having progressively increasing tip chords were included. Data were obtained for angles of attack up to approximately -32 deg, model roll angles of 0 deg to 45 deg, and tail control deflections of 0 deg and -20 deg. The experimental drag due to lift was compared with linear values. Author

N78-12033* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EFFECTS OF EXTERNAL STORES ON THE AERODYNAMIC CHARACTERISTICS OF A 60 DEG DELTA-WING FIGHTER MODEL AT MACH 1.60 TO 2.87
M. Leroy Spearman Dec. 1977 33 p refs
(NASA-TM-74090; L-11917) Avail: NTIS HC A03/MF A01 CSCL 01A

An investigation was conducted to determine the effects of wing mounted external stores on the longitudinal and lateral aerodynamic characteristics of a 60 deg delta wing fighter model with aft tail controls. Data are presented for the clean configuration and for various combinations of pylons and stores. Data were obtained for angles of attack to approximately 22 deg and tail control deflections of 0 deg and -10 deg. Author

N78-12034*# Advanced Technology Labs., Inc., Westbury, N. Y.
COMPUTATION OF UNSTEADY TRANSONIC FLOWS THROUGH ROTATING AND STATIONARY CASCADES. 2: USER'S GUIDE TO FORTRAN PROGRAM B2DATL Final Report
Edgar Alzner and Paul P. Kalben Nov. 1977 81 p refs
(Contract NAS3-16807)
(NASA-CR-2901; ATL-TR-205-Vol-2) Avail: NTIS HC A03/MF A01 CSCL 01A

Documentation for the FORTRAN program B2DATL is provided. The program input, output, and operational procedures are described; a dictionary of the principal FORTRAN variables is provided; the function of all subroutines; is outlined and flow charts of the principal subroutines and the main program are presented. Author

N78-12035*# Advanced Technology Labs., Inc., Westbury, N. Y.
COMPUTATION OF UNSTEADY TRANSONIC FLOWS THROUGH ROTATING AND STATIONARY CASCADES. 3: ACOUSTIC FAR-FIELD ANALYSIS Final Report
Simon Slutsky, Dietrich Fischer, and John I. Erdos Nov. 1977 56 p refs
(Contract NAS3-16807)
(NASA-CR-2902; ATL-TR-205-Vol-3) Avail: NTIS HC A04/MF A01 CSCL 01A

A small perturbation type analysis has been developed for the acoustic far field in an infinite duct extending upstream and downstream of an axial turbomachinery stage. The analysis is designed to interface with a numerical solution of the near field of the blade rows and, thereby, to provide the necessary closure condition to complete the statement of infinite duct boundary conditions for the subject problem. The present analysis differs from conventional inlet duct analyses in that a simple harmonic time dependence was not assumed, since a transient signal is generated by the numerical near-field solution and periodicity is attained only asymptotically. A description of the computer code developed to carry out the necessary convolutions numerically is included, as well as the results of a sample application using an impulsively initiated harmonic signal. Author

N78-12036*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
ON THE LOGARITHMIC-SINGULARITY CORRECTION IN THE KERNEL FUNCTION METHOD OF SUBSONIC LIFTING-SURFACE THEORY

C. Edward Lan (Kans. Univ., Lawrence) and John E. Lamar Washington Nov. 1977 55 p refs
(NASA-TN-D-8513; L-11142) Avail: NTIS HC A04/MF A01 CSCL 01A

A logarithmic-singularity correction factor is derived for use in kernel function methods associated with Multhopp's subsonic lifting-surface theory. Because of the form of the factor, a relation was formulated between the numbers of chordwise and spanwise control points needed for good accuracy. This formulation is developed and discussed. Numerical results are given to show the improvement of the computation with the new correction factor. Author

N78-12037*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
PERFORMANCE OF TWIN TWO-DIMENSIONAL WEDGE NOZZLES INCLUDING THRUST VECTORING AND REVERSING EFFECTS AT SPEEDS UP TO MACH 2.20
Francis J. Capone and Donald L. Maiden Washington Jul. 1977 190 p refs
(NASA-TN-D-8449; L-11277) Avail: NTIS HC A09/MF A01 CSCL 01A

Transonic tunnel and supersonic pressure tunnel tests were reformed to determine the performance characteristics of twin nonaxisymmetric or two-dimensional nozzles with fixed shrouds and variable-geometry wedges. The effects of thrust vectoring, reversing, and installation of various tails were also studied. The investigation was conducted statically and at flight speeds up to a Mach number of 2.20. The total pressure ratio of the simulated jet exhaust was varied up to approximately 26 depending on Mach number. The Reynolds number per meter varied up to 13.20 x 1 million. An analytical study was made to determine the effect on calculated wave drag by varying the mathematical model used to simulate nozzle jet-exhaust plume. Author

N78-12038*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
AERODYNAMIC CHARACTERISTICS AT MACH NUMBERS FROM 0.33 TO 1.20 OF A WING-BODY DESIGN CONCEPT FOR A HYPERSONIC RESEARCH AIRPLANE
James L. Dillon and Jimmy L. Pittman Dec. 1977 76 p refs
(NASA-TP-1044; L-11723) Avail: NTIS HC A05/MF A01 CSCL 01A

An experimental investigation of the static aerodynamic characteristics of a model of one design concept for the proposed National Hypersonic Flight Research Facility was conducted in the Langley 8 foot transonic pressure tunnel. The experiment consisted of configuration buildup from the basic body by adding a wing, center vertical tail, and a three module or six module scramjet engine. The freestream test Mach numbers were 0.33, 0.80, 0.90, 0.95, 0.98, 1.10, and 1.20 at Reynolds numbers per meter ranging from 4.8 x 1 million to 10.4 x 1 million. The test angle of attack range was approximately -4 deg to 22 deg at constant angles of sideslip of 0 deg and 4 deg; the angle of sideslip ranged from about -6 deg to 6 deg at constant angles of attack of 0 deg and 17 deg. The elevons were deflected 0 deg, -10 deg, and -20 deg with rudder deflections of 0 deg and 15.6 deg. Author

N78-12039*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
AN EXPERIMENTAL AND ANALYTICAL INVESTIGATION OF PROPROTOR WHIRL FLUTTER
Raymond G. Kvaternik and Jerome S. Kohn (Grumman Aerospace Corp., Bethpage, N. Y.) Dec. 1977 76 p refs
(NASA-TP-1047; L-11656) Avail: NTIS HC A05/MF A01 CSCL 01A

The results of an experimental parametric investigation of whirl flutter are presented for a model consisting of a windmilling propeller-rotor, or proprotor, having blades with offset flapping hinges mounted on a rigid pylon with flexibility in pitch and yaw. The investigation was motivated by the need to establish a large data base from which to assess the predictability of whirl flutter for a proprotor since some question has been raised as to whether flutter in the forward whirl mode could be predicted with confidence. To provide the necessary data base, the parametric study included variation in the pylon pitch and yaw stiffnesses, flapping hinge offset, and blade kinematic pitch-flap coupling over a large range of advance ratios. Cases of forward whirl flutter and of backward whirl flutter are documented. Measured whirl flutter characteristics were shown to be in good agreement with predictions from two different linear stability analyses which employed simple, two dimensional, quasi-steady aerodynamics for the blade loading. On the basis of these results, it appears that proprotor whirl flutter, both forward and backward, can be predicted. Author

N78-12040*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
SPIN-TUNNEL INVESTIGATION OF THE SPINNING CHARACTERISTICS OF TYPICAL SINGLE-ENGINE GENERAL AVIATION AIRPLANE DESIGNS. 2: LOW-WING MODEL A; TAIL PARACHUTE DIAMETER AND CANOPY DISTANCE FOR EMERGENCY SPIN RECOVERY
Sanger M. Burk, Jr., James S. Bowman, Jr., and William L. White Washington Nov. 1977 30 p refs
(NASA-TP-1076; L-11804) Avail: NTIS HC A03/MF A01 CSCL 01A

A spin tunnel study is reported on a scale model of a research airplane typical of low-wing, single-engine, light general aviation airplanes to determine the tail parachute diameter and canopy distance (riser length plus suspension-line length) required for emergency spin recovery. Nine tail configurations were tested, resulting in a wide range of developed spin conditions, including steep spins and flat spins. The results indicate that the full-scale parachute diameter required for satisfactory recovery from the most critical conditions investigated is about 3.2 m and that the canopy distance, which was found to be critical for flat spins, should be between 4.6 and 6.1 m. Author

N78-12041*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
SUPERSONIC AERODYNAMIC CHARACTERISTICS OF A SPARROW 3 TYPE MISSILE MODEL WITH WING CONTROLS AND COMPARISON WITH EXISTING TAIL-CONTROL RESULTS
William J. Monta Nov. 1977 84 p refs
(NASA-TP-1078; L-11715) Avail: NTIS HC A05/MF A01 CSCL 01A

An experimental investigation was conducted on a model of a wing control version of the Sparrow III type missile to determine the static aerodynamic characteristics over an angle of attack range from 0 deg to 40 deg for Mach numbers from 1.50 to 4.60. Author

N78-12042# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
A MINIMUM INDUCTIVE RESISTANCE WING NEAR THE SURFACE OF THE EARTH
Yu. L. Zhilin 7 Feb. 1977 17 p Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Mekh. i Mashinostroyeniye, Izd-Vo (USSR), n. 1, 1964 p 148-150
(AD-A044690; FTD-ID(RS)I-037-77) Avail: NTIS HC A02/MF A01 CSCL 20/4

The problem of a wing of finite span possessing minimum resistance with a given lift in an incompressible flow was considered. Mathematical relationships were derived for lift and drag coefficients, circulation distributions and vortices. B.L.P.

N78-12043# Weapons Research Establishment, Salisbury (Australia).
CALCULATION OF PRESSURE DISTRIBUTIONS ON TWO AXISYMMETRIC BOATTAILED CONFIGURATIONS
M. K. Haselgrove Feb. 1977 24 p
(AD-A044952; WRE-TR-1779(W)) Avail: NTIS HC A02/MF A01 CSCL 19/2

Two published computer programs are used to calculate the pressure distributions on two axisymmetric boattailed configurations in inviscid, incompressible flow. Realistic results are obtained in the base region by extending the body surface to simulate the surface streamline separating from the base. The results show that a favorable pressure gradient is created by replacing the rear portion of a boattail by a cylindrical section, and conversely

an adverse gradient on a boattail is strengthened by the presence of a large sting on wind-tunnel models. Author (GRA)

N78-12044# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
REGULARIZATION OF THE SINGULAR INTEGRAL EQUATION FOR A WING IN AN UNSTEADY SUBSONIC GAS FLOW
Yu. A. Abramov 7 Feb. 1977 22 p refs Transl. into ENGLISH from Tr. Irkutsk. Politechn. Inst. (USSR), no. 52, 1969 p 218-224
(AD-A044670; FTD-ID(RS)I-0099-77) Avail: NTIS HC A02/MF A01 CSCL 20/4

This study attempts to regularize the singular integral equation for a wing in an unsteady subsonic plane-parallel gas flow in acceleration potential space, obtain the Fredholm equation for determining the distribution function gamma(xi), and find the asymptotic solution. GRA

N78-12045# ARO, Inc., Arnold Air Force Station, Tenn.
NUMERICAL COMPUTATION OF SUBSONIC CONICAL DIFFUSER FLOWS WITH NONUNIFORM TURBULENT INLET CONDITIONS Final Report, Oct. 1976 - May 1977
J. C. Chien AEDC Sep. 1977 75 p refs
(ARO Proj. R33A-03A)
(AD-A044948; ARO-ETF-TR-77-44; AEDC-TR-77-78) Avail: NTIS HC A04/MF A01 CSCL 20/4

Numerical solutions of the Navier-Stokes equations are obtained and results presented for conical diffuser flows with turbulent nonuniform inlet conditions. The turbulent flow field is described by a two-equation, low-Reynolds-number k-epsilon model with a new turbulence model for axisymmetric flow. Fast convergence is achieved with an improved initial flow-field guess and a multiple grid Gauss-Seidel iteraction method. Comparisons are made with existing data for several diffuser divergence angles with and without flow separation. Good agreement was obtained between theory and experiment. Author (GRA)

N78-12046# Naval Surface Weapons Center, Dahlgren, Va.
SUBSONIC WIND TUNNEL TESTS OF A CANARD-CONTROL MISSILE CONFIGURATION IN PURE ROLLING MOTION Technical Report, 1 Jul. 1975 - 31 Oct. 1976
Samuel R. Hardy Jun. 1977 90 p refs
(WF32323201; WF32300000)
(AD-A044957; NSWC/DL-TR-3615) Avail: NTIS HC A05/MF A01 CSCL 20/4

The description and run log of subsonic wind tunnel tests on a canard-control missile in pure rolling motion are presented. Test data for the body plus canard plus tail configuration (with 0-deg deflections) of the canard-control missile are shown. The nonlinear second-order differential equation of motion used in the global nonlinear least-squares analysis of the test data is discussed. Nonlinear aerodynamic coefficients extracted from the test data are presented and discussed. The results for the body plus canard plus tail configuration with 0-deg deflections showed that the linear roll damping moment coefficient increases slightly with the angle of attack up to about 20 deg, as predicted. However, at 30 deg the coefficient decreases significantly. Author (GRA)

N78-12047# Princeton Univ., N. J. Dept. of Aerospace and Mechanical Sciences.
AERODYNAMIC AND HOVERING CONTROL OF LTA VEHICLES Final Report
W. F. Putman, M. Maugmher, H. C. Curtiss, Jr., and J. J. Traybar May 1977 155 p refs
(Contract N62269-76-C-0493)
(AD-A045315; AMS-TR-1339) Avail: NTIS HC A08/MF A01 CSCL 20/4

Recent U.S. Navy interest in air vehicles for application to advanced naval missions has pointed out a need for technology development in certain areas to support parametric and point design studies in the Advanced Naval Vehicle Concepts Evaluation (ANVCE) program. Among those technologies requiring study were the aerodynamics and precision hover control characteristics of Lighter-Than-Air (LTA) vehicles. LTA, or buoyant assisted lift, vehicles offer potentially significant increases in on-station endurance over conventional aircraft. To evaluate fully this potential, however, it is important to have a sound aerodynamic description of these aircraft that can be relied upon to give accurate representations of their performance, stability and control requirements. The present study is intended to provide a basis for the aerodynamic characterization of LTA vehicles suited to parametric studies, point design and even preliminary design efforts. The study employs combinations of applicable theory, experiment and empiricisms to represent the aerodynamic characteristics of conventional airship (body-of-revolution) and delta shapes, the latter shape having applicability to hybrid aircraft utilizing both aerodynamic and aerostatic lift. Additionally, the potential of boundary layer control for drag reduction in conventional airships is reviewed and the basic aspects of hovering control of LTA vehicles are developed. Author (GRA)

N78-12048# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Aerospace and Ocean Engineering.
TRANSONIC SHOCK-TURBULENT BOUNDARY LAYER INTERACTION WITH SUCTION AND BLOWING
G. R. Inger and S. Zee Sep. 1977 57 p refs
(Contract N00014-75-C-0456)
(AD-A045317; VPI-AERO-073) Avail: NTIS HC A04/MF A01 CSCL 20/4

A basic theory of weak normal shock - turbulent boundary layer interactions is given for two-dimensional non-separating flows including mass transfer across the wall throughout the interaction region. Even small amounts of suction are found to significantly reduce both the streamwise scale and thickening effect of the interaction and delay the onset of separation. This is shown to be a consequence of the large mass transfer effect on the shape of the incoming boundary layer Mach number profile away from the wall. Parametric study results showing the influence of Reynolds and shock Mach number as well as mass transfer parameter on the interaction, plus favorable comparisons with various experimental data, are also presented. GRA

N78-12049# Sandia Labs., Albuquerque, N. Mex.
B77 FLIGHT TEST DATA PROCESSING
R. E. Humphrey and E. D. Holbrook Mar. 1977 88 p
(Contract EY-76-C-04-0789)
(SAND-77-8010) Avail: NTIS HC A05/MF A01

A system of equations which can be used to obtain aerodynamic forces and moments, angles of attack and sideslip, and aerodynamic coefficients from flight test data obtained from the B77 flight test program is presented. In this revision of the earlier report, the original system of equations has been extended to present the aerodynamic forces and moments in terms of their components in the parachute-fixed coordinate system. Equations which describe the aircraft-bomb separation dynamics are included. ERA

03 AIR TRANSPORTATION AND SAFETY

Includes passenger and cargo air transport operations; and aircraft accidents.

For related information see also *16 Space Transportation* and *85 Urban Technology and Transportation*.

N78-12050# Civil Aeromedical Inst., Oklahoma City, Okla.
THE 1975 ACCIDENT EXPERIENCE OF CIVILIAN PILOTS WITH STATIC PHYSICAL DEFECTS
J. Robert Dille and Charles F. Booze Aug. 1977 9 p refs
(AD-A045429; FAA-AM-77-20) Avail: NTIS HC A02/MF A01 CSCL 01/2

The 1974 aircraft accident experience of civilian pilots with selected static physical defects was examined and reported previously. Conditions of blindness or absence of either eye, deficient color vision with a waiver, and deficient distant vision were present in significantly more accidents than were expected. Pilots with these conditions reported considerably higher median 6 month flight times than did an active airman population sample or accident airmen without selected pathology. Concern was raised about the failure to relate any of the accidents to

the pilot's physical conditions. The 1975 accident data were examined, and the same three groups were found to have significantly more accidents. The reported recent and total flying times for all airmen with these defects were determined and accident rates were calculated. When the accident experience of airmen with any of these defects was compared with the active airman population accident experience, the rates for airmen with blindness or absence of an eye were still found to be significantly higher. Author

N78-12051# BioTechnology, Inc., Falls Church, Va.
AN EVALUATION OF THE NAVY UNDERSEA WEAPONS TANK FOR TESTING AIRCREW ESCAPE, SURVIVAL, AND RESCUE PROCEDURES AND EQUIPMENT Final Report
Martin G. Every and Michael C. Brody Sep. 1977 27 p
(Contract N00014-77-C-0253; NR Proj. 207-007)
(AD-A044847) Avail: NTIS HC A03/MF A01 CSCL 06/7

This report evaluates the Navy Undersea Weapons Tank, White Oak, Maryland to determine its suitability as a test facility to conduct and document research relating to in-water escape, survival, and rescue following an aircraft or helicopter mishap. After consideration of factors such as safety, suitability for experimentation, data recording, and emergency medical care, this facility was shown to be excellent for this type of testing. Much of the photographic documentation shown in this report was accomplished during tests involving underwater parachute entanglement and rescue of live subjects. Author (GRA)

N78-12052# Energy Systems Corp., Nashua, N. H.
DOWNED AIRMAN POWER SOURCE (DAPS) FOR INCLUSION INTO THE RSSK-8A AIRCRAFT EJECTION SEAT TO BE USED BY DOWNED PILOTS FOR ENVIRONMENTAL ANTI-EXPOSURE PROTECTION Final Report, 10 Apr. 1976 - 10 Jan. 1977
Richard E. LeCompte and Roger S. Christie Jan. 1977 168 p
(Contract N62269-76-C-0239; WF51523400)
(AD-A044483; ESC-0239-1FR; NADC-75340-40) Avail: NTIS HC A08/MF A01 CSCL 13/1

A source of heat to extend survival time during search and rescue operations for downed airman in cold environments was devised. The heat source is derived from the catalytic combustion of propane fuel with resultant release of chemical energy in the form of heat. The heat is picked up by a heat transfer fluid in heat exchangers, and pumped to the man via umbilicals on the DAPS to a tubulated under garment worn by the airman where the heat is dumped. The system is a closed loop, and therefore, after dumping its heat the fluid is returned to the DAPS where it picks up additional heat. The system is capable of supplying up to 250 thermal watts to the airman at fluid temperatures of approximately 100 to 105 F. The fluid flow rate is approximately .25 to .30 gallons per minute. The system also has a 12 VDG DC-DC converter used to power an emergency flasher or transmitter. GRA

N78-12053# Energy Systems Corp., Nashua, N. H.
DOWNED AIRMAN POWER SOURCE (DAPS) FOR INCLUSION INTO THE RSSK-1A AIRCRAFT EJECTION SEAT TO BE USED BY DOWNED PILOTS FOR ENVIRONMENTAL ANTIPOSURE PROTECTION Final Report, 10 Apr. 1976 - 10 Jan. 1977
Richard E. LeCompte and Roger S. Christie Jan. 1977 180 p
(Contract N62269-76-C-0289)
(AD-A044481; ESC-0289-1FR; NADC-76045-40) Avail: NTIS HC A09/MF A01 CSCL 13/1

For abstract, see N78-12052.

04 AIRCRAFT COMMUNICATIONS AND NAVIGATION

Includes digital and voice communication with aircraft; air navigation systems (satellite and ground based); and air traffic control.

For related information see also *17 Spacecraft Communications, Command, and Tracking* and *32 Communications.*

N78-12054# Army Missile Research, Development and Engineering Lab., Redstone Arsenal, Ala. Guidance and Control Directorate.
PERSHING PII INERTIAL MEASUREMENT UNIT FIELD GYROCOMPASS TEST
H. V. White Jun. 1977 105 p
(AD-A043921; DRDMI-TG-77-16) Avail: NTIS HC A06/MF A01 CSCL 17/7

This report presents a description of the PERSHING PII Inertial Measurement Unit field gyrocompass test which provided the first accuracy data outside a benign laboratory environment. Results are presented and discussed. It was determined that RMS and average errors increased under field conditions but the standard deviation, about the average at each azimuth heading for which data were taken, was essentially the same as laboratory results. A temperature related anomaly was identified which will be an item for close scrutiny during future tests. No catastrophic performance breakdown occurred; however, since errors tend to grow when the equipment is operated outside a benign laboratory environment, no relaxation of the current gyrocompass accuracy specification is recommended. Author (GRA)

N78-12055# Aeronautical Systems Div., Wright-Patterson AFB, Ohio. Human Factors Branch.
MICROWAVE LANDING SYSTEM UTILIZATION AND CONVENTIONAL AVIONICS Final Report, 15 Aug. - 1 Nov. 1974
Thomas W. Showalter May 1976 66 p
(AD-A044297; ASD-TR-76-7) Avail: NTIS HC A04/MF A01 CSCL 17/7

The study examined the effects of flying different microwave landing system approach profile designs with various types of conventional avionics. All the conventional systems used possessed similar limitations in that they were unable to present course guidance throughout the microwave landing system profiles. The loss of course guidance adversely affected pilot performance and, on occasion, made for unsafe conditions. Author (GRA)

N78-12056# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Systems and Logistics.
SIMULATION OF AN AIR TRAFFIC CONTROL TERMINAL AREA M.S. Thesis
James M. Gibbar and Gary E. Lorenz Jun. 1977 192 p refs
(AD-A044211; AFIT-LSSR-15-77a) Avail: NTIS MF A01 CSCL 17/7

The air traffic controller is at the apex of a complex information system. High volume air traffic often precludes thorough data analysis by the controller and reduces his ability to plan for optimum traffic flow. Simulation offers a means to evaluate changes in air traffic control procedures or facilities. Such changes could assit the controller in maintaining optimum traffic flow. This research involved the development of a computer simulation model of an approach control area. Experiments were conducted on the model to test the effect of various changes in procedures and facilities. The results of the experiments were inconclusive. Author (GRA)

N78-12057# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Systems and Logistics.
AN ANALYSIS OF THE EXPONENTIAL FUNCTION AS THE UNDERLYING DISTRIBUTION FOR DESCRIBING FAILURES IN INERTIAL MEASUREMENT UNITS M.S. Thesis
Lowell R. Crowe and Levi D. Lowman, Jr. Jun. 1977 186 p refs
(AD-A044189; AFIT-LSSR-22-77A) Avail: NTIS MF A01 CSCL 17/7

This study examined the assumption that the underlying failure distribution for inertial measurement units is exponential. Failure data from three inertial measurement units, the KT-73 unit from the A-7D/E and AC-130H, the FLIP unit from the C-5A, and the LN-15 unit from the B-52G/H, were analyzed by use of the SIMFIT computer program. This program is a curve fitting technique employed for fitting a sample of data to twelve theoretical distributions. The research hypothesis was to show that the 'exponential assumption' of failures for the above units was inappropriate by finding a failure distribution which would

better model the failure data. The results indicated that the gamma was, in fact, the best model of the distributions tested and several other models, such as the Weibull and lognormal, were generally found to be better than the exponential model. Other areas of reliability discussed include renewal, data aggregation, and infant mortality. Author (GRA)

N78-12058# Hughes Research Labs., Malibu, Calif.
ROTATING GRAVITY GRADIOMETER DEVELOPMENT, VOLUME 1 Final Report, 1 Aug. 1975 - 31 Jan. 1977
C. B. Ames, R. B. Clark, P. M. LaHue, and R. W. Peterson Apr. 1977 174 p
(Contract F19628-76-C-0107; ARPA Order 2895)
(AD-A044161; AFGL-TR-77-0098-Vol-1) Avail: NTIS HC A08/MF A01 CSCL 17/7

Because the scope of work included both the development of the (RGG), Rotating Gravity Gradiometers, and studies of platform requirements, this Final Report is written in two volumes to better distinguish between these two major tasks. Volume 1 addresses the tasks associated with the sensor development and Volume 2, written under subcontract by Incosym, Inc., presents the findings and preliminary specifications for an inertial platform to support the RGG in airborne environment. The performance goals for the RGG remain identical to the original AFGL/DMA/DARPA statements made for the two prior AFGL contracts. Specifically, Hughes has been directed toward achieving gravity gradiometer performance in an airborne environment such as that provided by a C-135/C-141 aircraft flying in benign weather conditions. The gradiometer system performance goal is to determine the components of the gravity gradient tensor to an accuracy such that the individual RGG contributes no more than one (1) Eotvos Unit (EU) of noise when measured with an equivalent 10-second integration time. GRA

N78-12059# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
RADIO ENGINEERING SYSTEM OF SHORT-RANGE NAVIGATION. RSBN-2, PART 1
Ye. M. Yakovlev and A. N. Klepikov 9 Feb. 1977 318 p Transl. into ENGLISH of the book "Radiotekhnicheskaya Sistema Blizhney Navigatsii RSBU-2" Moscow, Izd. Transport, 1971 p 1-104
(AD-A044697; FTD-ID(RS)T-0017-77-Pt-1) Avail: NTIS HC A14/MF A01 CSCL 17/7

Contents: U.S. Board on Geographic Names Transliteration System; Greek Alphabet; Designations of Trigonometric Functions; Graphics Disclaimer; Chapter I. General Information; Chapter II. Antenna Feeder Units; Chapter III. Transmitters; Chapter IV. Ground-Based Receptors; Chapter V. Ground-Based Display Unit; Chapter VI. Equipment for Monitoring Azimuth and Inspection of Zero of Range; Chapter VII. Stabilized Drive of the Rotation of Azimuth Antenna; and Chapter VIII. Electric Power Supply. GRA

N78-12060# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
RADIO ENGINEERING SYSTEM OF SHORT-RANGE NAVIGATION. RSBN-2, PART 2
Ye. M. Yakovlev and A. N. Klepikov 9 Feb. 1977 399 p Transl. into ENGLISH of the book "Radiotekhnicheskaya Sistema Blizhney Navigatsii RSBN-2" Moscow, Izd. Transport, 1971 p 112-217
(AD-A044698; FTD-ID(RS)T-0017-77-Pt-2) Avail: NTIS HC A17/MF A01 CSCL 17/7
For abstract, see N78-12059.

N78-12061# Electronics Engineering Group (1042nd), Richards-Gebaur AFB, Mo. Transmission Systems Branch.
PATH TESTING
Paul Vavrek 30 Aug. 1977 36 p refs
(AD-A044549; Rept-1842 EEG/EET-TR-77-22) Avail: NTIS HC A03/MF A01 CSCL 20/14

Microwave path testing is necessary to confirm path performance predictions, field surveys and to optimize transmission quality by determining the best antenna heights to minimize fading due to reflections. Path testing is the most accurate method for identifying path obstructions, confirming adequacy of map details and for precluding engineering errors. The objective of this report is to emphasize the importance of path testing and to provide a brief description of the path testing techniques being used today. Author (GRA)

N78-12062# Draper (Charles Stark) Lab., Inc., Cambridge, Mass.
DEVELOPMENT OF CAPABILITY FOR MULTIFUNCTION INTEGRATED REFERENCE ASSEMBLY EVALUATION Final Technical Report, 1 Jun. 1976 - 31 Mar. 1977
K. Daly, R. Nurse, G. Schmidt, P. Motyka, and P. Palmer Wright-Patterson, AFB, Ohio AFAL Jul. 1977 118 p refs
(Contract F33615-76-C-1216)
(AD-A044849; R-1042; AFAL-TR-77-64) Avail: NTIS HC A06/MF A01 CSCL 01/3

The significance of this research and development to the Air Force is the development of the tools and techniques required to assess the feasibility of using a minimum number of inertial sensors to provide the inertial reference information consistent with aircraft requirements for weapon delivery, flight control, navigation, fire control, and flight safety. Multifunction Inertial Reference Assembly (MIRA) is the term which describes the generic class of systems designed to meet this objective. Emphasis is placed on the development of a simulation capability for the evaluation of MIRA systems in realistic environments. A definition of the aircraft and flight-control system selected for the simulation is included along with a consideration of the inertial-sensor requirements for MIRA systems. Results demonstrating the capability of the simulation are presented. The life-cycle-cost implications of the MIRA approach are also dealt with. Author (GRA)

N78-12063# Science Applications, Inc., Bedford, Mass.
EJECTA SIZING FOR MIDDLE GUST TEST SERIES AND A REVIEW OF EJECTA DYNAMICS Final Report, 1 Aug. 1975 - 1 Oct. 1976
Harold J. Linnerud 22 Apr. 1977 67 p refs
(Contract DNA001-76-C-0109)
(AD-A043325; SAI-76-507-BOS; DNA-4230F) Avail: NTIS HC A04/MF A01 CSCL 19/4

In-flight of crater ejecta are summarized for the Middle GUST test series. Observed distributions tend to support power law distribution currently used in models when the latter are filtered by gravitational and acrodynamic effects. The feasibility of obtaining data on ejecta dynamics to correlate with cratering calculations is reviewed. Author (GRA)

N78-12064# Naval Research Lab., Washington, D. C.
A STUDY OF THE P-3C OMEGA NAVIGATION SYSTEM M.S. Thesis
James Joseph Frydrychowicz Jun. 1977 92 p refs
(AD-A044474) Avail: NTIS HC A05/MF A01 CSCL 17/7

This thesis is a study of the Omega navigation system as currently implemented in the P-3C aircraft. The possibility of using a microcomputer to solve the internal processing functions is investigated. Data flow graphs were applied to the velocity and navigation processing function in the Omega system. These graphs assisted in the development of the PL/M code which implements the function. The four PL/M subroutines that were written can compute the velocity and navigation equations in sufficient time and with sufficient accuracy to encourage additional research into a microcomputer implementation of the remaining internal functions of the Omega system. Author (GRA)

05 AIRCRAFT DESIGN, TESTING AND PERFORMANCE

Includes aircraft simulation technology.

For related information see also *18 Spacecraft Design, Testing and Performance* and *39 Structural Mechanics*.

N78-12065 Kansas Univ., Kansas City.
FLIGHT EVALUATION OF AN ADVANCED TECHNOLOGY LIGHT TWIN-ENGINE AIRPLANE (ATLIT) Ph.D. Thesis
Bruce John Holmes 1976 288 p
Avail: Univ. Microfilms Order No. 77-16339

The project organization and execution, the airplane descrip-

tion and performance predictions, and the results of the flight evaluation of an advanced technology light twin-engine airplane (ATLIT) are presented. Stalling and the rolling characteristics met design expectations. The cruise and climb performance did not meet the predictions. Climb performance was penalized by extensive flow separation in the region of the wing-body juncture. Cruise performance was found to be penalized by a large value of zero-lift drag. Calculations showed that, with proper attention to construction details, the improvements in span efficiency and zero-lift drag would permit the realization of the predicted increases in cruising maximum rate-of-climb performance. Dissert. Abstr.

N78-12066 Engineering Sciences Data Unit, London (England).
LOST RANGE, FUEL AND TIME DUE TO CLIMB AND DESCENT: PROPELLER-DRIVEN AEROPLANES
Jul. 1977 9 p
(ESDU-77015; ISBN-0-85679-186-5) For information on availability of series, sub-series and other individual data items, write NTIS, Attn: ESDU, Springfield, Va. 22161. HC $146.50

Propeller driven airplanes powered by piston or turbine engines were considered. Quantities of 'lost' range, 'lost' fuel and 'lost' time due to climb and descent were calculated. The use of these quantities permits estimates of still air range, fuel and time based on cruise performance alone to be adjusted for the effects of climb and descent. The method is based on the concept of energy height. It is best suited to preliminary calculations at a stage when the available airframe, engine and propeller data are minimal and for cases where the distances flown in climb and descent are not a substantial part of the total flight distance. ESDU

N78-12067# Army Missile Research and Development Command, Redstone Arsenal, Ala. Aeroballistics Directorate.
AEROBALLISTIC STUDY OF AN ATTACK MINI-RPV
Rex B. Powell, Donald W. Holder, and Richard E. Dickson 13 Jul. 1977 83 p refs
(DA Proj. 1L3-62303-A-214)
(AD-A044028; DRDMI-TD-77-16) Avail: NTIS HC A05/MF A01 CSCL 01/3

This report presents the results of an aeroballistic study of an attack mini-RPV. The work was performed by the Aeroballistics Directorate during the period from January 1972 to January 1976. Author (GRA)

N78-12068# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Systems and Logistics.
A METHOD FOR AUGMENTING THE ADVANCED CONFIGURATION MANAGEMENT SYSTEM FOR NATIONS OPERATING F-4 AIRCRAFT UNDER THE UNITED STATES INTERNATIONAL LOGISTICS PROGRAM M.S. Thesis
Gordon F. Boswell and Thomas E. Distelhorst Jun. 1977 127 p refs
(AD-A044173; AFIT-LSSR-23-77A) Avail: NTIS HC A07/MF A01 CSCL 05/1

The F-4 Technical Coordination Group (TCG) at the Ogden Air Logistics Center has the responsibility for configuration accounting of F-4s sold abroad under the International Logistics Program. The TCG uses a combination of the U.S. Air Force Advanced Configuration Management System and a manual recordkeeping system. The manual system has had to be used extensively due to peculiarities of foreign nations: configuration accounting needs. These manual methods have been very time consuming for the TCG. This research developed a computer model to take the place of the manual system methods. The computer model was found to be a faster method of accomplishing TCG configuration accounting tasks while performing at an equivalent level of accuracy. Author (GRA)

N78-12069# Naval Intelligence Support Center, Washington, D. C. Translation Div.
AN APPROXIMATE METHOD OF CALCULATING DOWNWASH BEHIND A STRAIGHT WING WITH UNSTEADY APERIODIC MOTION AT SUBSONIC FLIGHT SPEEDS
O. M. Panchenko 25 Jul. 1977 15 p Transl. into ENGLISH from Samoletostr. Tekh. Vozdush. Flota (USSR), no. 19, 1970 p 6-17
(AD-A044293; NISC-Trans-3945) Avail: NTIS HC A02/MF A01 CSCL 20/4

The calculation of downwash at the aircraft tail unit is a comparatively simple problem under stationary conditions. Unsteady downwashes created by a wing are more difficult to determine. The investigation of downwash created by a wing during harmonic vibration was presented in a quite general way in a work. The question of investigating unsteady downwashes during aperiodic motion is of equal practical interest because one must study the motion of an object with aperiodic relationships of the kinematic parameters and time when the aircraft vertically zoom-climbs (breaks away), changes from one angle of attack to another, etc. This article presents a numerical method of calculating downwash angles at the aircraft tail unit for unsteady aperiodic motion at subsonic speeds. Only straight, untwisted wings are examined, but it seems possible to devise a similar method for wings of any shape with aerodynamic or geometric twist. GRA

N78-12070# Aeronautical Systems Div., Wright-Patterson AFB, Ohio. Crew Equipment and Human Factors Div.
CREW COMPOSITION STUDY FOR AN ADVANCED TANKER/CARGO AIRCRAFT (ATCA) Final Report, Jan. 1975 - Jan. 1976
Richard J. Schiffler, Richard Geiselhart, and Larry Ivey Oct. 1976 53 p 2 Vol.
(AD-A043969; ASD-TR-76-20) Avail: NTIS HC A04/MF A01 CSCL 05/9

To determine the minimum crew complement required for an Advanced Tanker/Cargo Aircraft a series of contractor and AF task analysis were reviewed and evaluated. Coupled with these analyses were a series of flight tests which verified some of task time and procedures required for Advanced Tanker/Cargo Aircraft. It was concluded that a three-man crew (P, CP, Boom Operator) had crew work overloads during several flight segments and this crew size would be unacceptable in a Emergency War Order (EWO) environment. A four-man crew (P, CP, N/FE and Boom Operator) was the most advantageous and could handle most tasks below a 100% task loading. Author (GRA)

N78-12071# Aeronautical Systems Div., Wright-Patterson AFB, Ohio. Crew Equipment and Human Factors Div.
A STUDY OF TASK LOADING USING A FOUR-MAN CREW ON A KC-135 AIRCRAFT (GIANT BOOM) Final Report, Jul. - Oct. 1976
Richard Geiselhart, Richard I. Koeteeuw, and Richard J. Schiffler Apr. 1977 40 p refs 2 Vol.
(AD-A044104; ASD-TR-76-33) Avail: NTIS HC A03/MF A01 CSCL 05/9

At the request of Strategic Air Command (SAC), human factors engineers and engineering psychologists participated in this KC-135 crew composition and task load analysis entitled GIANT BOOM. GIANT BOOM, a follow-on study to SAC's earlier GIANT CHANGE, determined the feasibility of a four-man KC-135 crew consisting of two pilots, a boom operator, and an enlisted Flight Systems Operator. This crew complement, with inertial navigation systems and radars for the pilots and Flight Systems Operators, demonstrated significantly reduced task loads on both pilots from those observed in GIANT CHANGE. Author (GRA)

N78-12072# Hughes Helicopters, Culver City, Calif.
OH-6A TAIL ROTOR TRANSMISSION GREASE EVALUATION AND FAIL DETECTION SYSTEM TEST Final Report, Sep. 1972 - Feb. 1976
B. R. Smith and G. Grigorian Jun. 1977 59 p
(Contract DAAJ01-70-A-0324)
(AD-A044635; HH-76-219; TSARCOM-77-2) Avail: NTIS HC A04/MF A01 CSCL 11/8

MCG 68-63 Grease was lab tested in the operation of two OH-6A and two OH-58A tail rotor transmissions. This may be an acceptable lubricant for this application where the transmission is filled to capacity and an increase in temperature (vs. MIL-L-23699) is not objectionable. Author (GRA)

N78-12073# Boeing Aerospace Co., Seattle, Wash. Logistics Support and Services.
HISTORICAL ANALYSIS OF C-130E RESOURCES Interim Report, 29 Jun. 1976 - 20 May 1977
Gary A. Brown, Donald E. Griswold, Donald K. Hindes, Gary A. Walker, and David H. Wilson Jul. 1977 251 p refs

(Contract F33615-76-C-0062; AF Proj. 1959)
(AD-A044712; AFHRL-TR-77-48) Avail: NTIS HC A12/MF A01 CSCL 01/3

This report presents the results of the collection and analysis of 15 years of C-130E Historical Resource Utilization data. The purpose of this study was to determine the type, quality and availability of resource utilization data for a specific weapon system. The information collected covers both human and material resource requirements. This type of information provides the baseline for planning for new weapon systems. It also establishes those areas of high utilization which may be reduced in the new system by possibly modifying some design parameter. A major problem encountered in this type of analysis is that the current Air Force management systems are not developed for historical evaluation. Frequently, the critical data are not available or in a form that makes it too costly to obtain. The resulting data bank was developed from existing Air Force data samples. Where only partial data was located, statistical methods were developed and applied to generate the missing data. Analyses were accomplished against seven (7) basic data categories, namely: (a) operations, (b) maintenance, (c) reliability, (d) safety, (e) human resources, (f) material resources, and (g) cost data. All data categories addressed, whenever possible, the 15 year period or life cycle of the C-130E weapon system (1962 through 1976). GRA

N78-12074# Naval Ship Research and Development Center, Bethesda, Md.
THE XBQM-108A VERTICAL ATTITUDE TAKEOFF AND LANDING VEHICLE Final Report
W. H. Eilertson Aug. 1977 56 p ref
(ZF61412001; WF41421200)
(AD-A044754; DTNSRDC-77-0073) Avail: NTIS HC A04/MF A01 CSCL 01/3

To assess the advantages of vertical attitude takeoff and landing, the Aviation and Surface Effects Department at the David W. Taylor Naval Ship Research and Development Center (DTNSRDC) designed and constructed a 560-lb demonstration vehicle (designated the XBQM-108A). The design incorporates a close-coupled canard/delta wing configuration that utilizes components from the MQM-74A target drone as well as the Harpoon missile. During the summer of 1976 this vehicle was successfully flight tested to assess vertical hover capability in a tethered hover flight mode. Other Navy laboratories cooperated in support of engine installation design and test (Naval Weapons Center), and guidance and control (Naval Underwater Systems Center). Free-flight tests in hover and ship docking are planned. The need for vertical takeoff capability is due to the current threat imposed on the Fleet by the advent of high-speed cruise missiles. This has increased the importance of dispersing aircraft to nonaviation ships should the need arise. The launch and recovery of RPV's and V/STOL manned aircraft aboard nonaviation ships has been identified by the Navy as a major design impact area. Vertical attitude takeoff and landing (VATOL) offers attractive advantages in that ship/aircraft interface docking problems are alleviated. The VATOL airframe design is lighter and cheaper than other candidate concepts and has superior performance. Author (GRA)

06 AIRCRAFT INSTRUMENTATION

Includes cockpit and cabin display devices; and flight instruments.

For related information see also *19 Spacecraft Instrumentation* and *35 Instrumentation and Photography*.

N78-12075# Mitre Corp., Bedford, Mass.
DIGITAL AVIONICS CASSETTE TRANSFER SYSTEM AND A PROGRAM LOADER FOR IBM SYSTEM/4Pi CP-2
A. M. Dahod Jul. 1977 158 p refs
(Contract F19628-76-C-0001; AF Proj. 6770)
(AD-A044020; MTR-3174) Avail: NTIS MF A01 CSCL 09/2

A portable cassette transport unit, the Digital Avionics Cassette Transfer System, and a portable direct-memory-access interface, the AGE Interface, have been developed to enable field loading and verification of the System/4Pi CP-2 memory. The Digital Avionics Cassette Transfer System (DACTS) is a user programmable information storage device with a general purpose parallel interface that can write or read information on a magnetic tape cassette. A cassette can store information for at least two, 8,448 thirty-six-bit-word CP-2 memories. The AGE Interface has a general purpose parallel input, and it can load and/or verify the System/4Pi CP-2 memory without the aid of any CP-2 software. This report gives functional, hardware and operating descriptions of the DACTS and the AGE Interface with procedures to load and verify the CP-2 memory. Author (GRA)

N78-12076# Hughes Aircraft Co., Culver City, Calif. Display Products Dept.
TRADEOFF STUDY FOR A HEAD-UP DISPLAY IN NEW TECHNOLOGIES Final Report, Mar. 1976 - Jan. 1977
W. N. Lewis, R. J. Withrington, D. H. Close, R. S. Jacobs, and R. A. Lohmann Aug. 1977 248 p refs
(Contract N62269-76-C-0231)
(AD-A044484; HAC-P77-45; HAC-Ref-D6541; NADC-753290-30) Avail: NTIS HC A11/MF A01 CSCL 20/6

The application of new technologies to advancing the state-of-the-art in Head-up displays is investigated. Current technologies are evaluated. Advanced designs are proposed and tradeoffs conducted using various new display and optical technologies such as diffraction optics, fiber optics, and liquid crystals. Author (GRA)

N78-12077# McDonnell Aircraft Co., St. Louis, Mo.
INTRASYSTEM ELECTROMAGNETIC COMPATIBILITY ANALYSIS PROGRAM (IEMCAP) F-15 VALIDATION. PART 1: VALIDATION AND SENSITIVITY STUDY Final Technical Report
R. A. Pearlman Griffiss AFB, N. Y. RADC Sep. 1977 203 p
(Contract F30602-76-C-0193)
(AD-A045034; RADC-TR-77-290-Pt-1) Avail: NTIS HC A10/MF A01 CSCL 09/3

This validation effort effectively demonstrates that the IEMCAP code can successfully predict the EMC performance characteristics of a modern Air Force weapon system. In this validation, using the F-15 aircraft as the measured baseline for comparison, the IEMCAP predicted the overall system compatibility, some isolated cases of interference, and the compatibility effectiveness of the subsequent fixes. Numerically, this means that for 353 coupling pairs in some three major coupling modes (wire-to-wire, antenna-to-antenna, and antenna-to-wire), IEMCAP successfully predicted 303 cases of compatibility, 7 cases of interference, (and the effectiveness of their subsequent fixes), and 43 Type I errors in which the code predicted interference when actual compatibility was present. There were no Type II errors in the analysis in which compatibility was predicted when interference was present. With this validated computerized analysis program, Air Force product divisions and their system contractors can facilitate the practical implementation of EMC design-to-cost at all stages of an Air Force system's life cycle with the attendant scheduling, testing, and cost benefits. This effort supports technical program objective CCC survivability (TPO 6RIC). Author (GRA)

N78-12078# McDonnell Aircraft Co., St. Louis, Mo.
INTRASYSTEM ELECTROMAGNETIC COMPATIBILITY ANALYSIS PROGRAM (IEMCAP) F-15 VALIDATION. PART 2: INTERPRETATION OF THE INTEGRATED MARGIN Final Technical Report
R. A. Pearlman Griffiss AFB, N. Y. RADC Sep. 1977 57 p refs 2 Vol.
(Contract F30602-76-C-0193)
(AD-A045035; RADC-TR-77-290-Pt-2) Avail: NTIS HC A04/MF A01 CSCL 09/3

The validity and usefulness of the Intra-system Electromagnetic Compatibility Analysis Program (IEMCAP) is assessed, based on its predictions for the F-15 air superiority fighter aircraft. The aircraft was simulated using a combination of known, measured and approximated data. A sensitivity study is also performed, indicating the effects of approximating unknown IEMCAP input parameters. Finally, a physical interpretation of the integrated EMI margin is given, and an assessment is made of its validity as an EMC figure merit. The IEMCAP is shown to successfully predict the known overall compatibility of the F-15,

and is also shown to predict interference between equipments in cases where receiver blanking is provided by the system. Cases in which the program incorrectly predicted interference are generally attributed to uncertainties in modeling non-required spectra rather than program inaccuracy. The results support a judgment that the integrated EMI margin is a valid figure of merit for most equipment used on aircraft systems, with the exception of threshold vulnerable devices. This report is divided into Part I and Part II. The first part of the report describes how the F-15 aircraft was used as data base for a shakedown of the IEMCAP code and an assessment of its predictions. The results of an input parameter is devoted to a detailed exposition on the meaning and physical significance of the integrated EMI margin, the quantity calculated by the IEMCAP as a measure of interference. Author (GRA)

N78-12079# Air Force Flight Test Center, Edwards AFB, Calif.
INVESTIGATION OF PITOT AND STATIC SYSTEM LEAK EFFECTS Final Report
Michael F. Marquardt Dec. 1976 85 p refs
(AD-A044956; AFFTC-TR-76-36) Avail: NTIS HC A05/MF A01 CSCL 01/4

This report presents the results of an investigation of the effects of leaks into pitot-static systems. Flight test data was obtained on a KC-135A. Ground tests on the aircraft pitot-static systems and laboratory tests produced the data needed to interpret the flight test results and to show the effects of parameters not investigated in flight. The program was initiated as a result of the AIMS related tests to identify and correct sources of altimetry system errors. The tests identified the primary parameters affecting leak-induced altimeter errors as leak hole size and pressure differential across the hole for a specific system geometry. Secondary effects were leak location, airspeed, and to a limited extent, altitude. The static system volume significantly affected the rate of change of change of indicated altimeter values during ground leak checks. Airspeed indicator errors due to pitot system leaks were primarily dependent on airspeed, cabin pressure, and leak hole size. The continued use of current Air Force pitot-static system leak check criteria should result in negligible airspeed and altitude errors. GRA

07 AIRCRAFT PROPULSION AND POWER

Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and on-board auxiliary power plants for aircraft.

For related information see also *20 Spacecraft Propulsion and Power, 28 Propellants and Fuels,* and *44 Energy Production and Conversion.*

N78-12080*# National Aeronautics and Space Administration, Washington, D. C.
HIGH TEMPERATURE CORROSION-RESISTANT PROTECTIVE COATINGS IN STATIONARY GAS TURBINES
H. W. Gruenling Nov. 1977 22 p refs Transl. into ENGLISH from Deutsche Ges. fuer Metallk. (Oberursel), 1974 p 168-195 and 197 Presented at the 3rd Tagung in Verbundwerkstoffe, Constance, West Ger. 28-29 Mar. 1974 Original language document was announced as A75-21910 Transl. by Kanner (Leo) Associates, Redwood City Calif. Original doc. prep. by Brown, Boveri und Cie, A.G., Mannheim (West Ger.)
(Contract NASw-2790)
(NASA-TM-75181) Avail: NTIS HC A02/MF A01 CSCL 21E

Methods currently used to deposit protective coatings in gas turbines are reviewed, and the structure of the respective coatings is examined. The corrosion behavior of such coatings is discussed on the basis of experimental data. General trends in the preparation of protective coatings are noted. Author

N78-12081*# Pratt and Whitney Aircraft Group, West Palm Beach, Fla. Government Products Div.
EVALUATION OF A LOW ASPECT RATIO SMALL AXIAL COMPRESSOR STAGE, VOLUME 1 Final Report
C. W. Sawyer, III Nov. 1977 148 p refs
(Contract NAS3-19424)
(NASA-CR-135240; PWA-FR-8499-Vol-1) Avail: NTIS HC A07/MF A01 CSCL 21E

A program was conducted to evaluate the effects of scaling, tip clearance, and IGV reset on the performance of a low aspect ratio compressor stage. Stage design was obtained by scaling an existing single stage compressor by a linear factor of 0.304. The design objective was to maintain the meanline velocity field of the base machine in the smaller size. Adjustments were made to account for predicted blockage differences and to chord lengths and airfoil edge radii to obtain reasonable blade geometries. Meanline velocity diagrams of the base stage were not maintained at the scaled size. At design speed and flowrate the scaled stage achieved a pressure ratio of 1.423, adiabatic efficiency of 0.822, and surge margin of 18.5%. The corresponding performance parameters for the base stage were 1.480, 0.872, and 25.2%, respectively. The base stage demonstrated a peak efficiency at design speed of 0.872; the scaled stage achieved a level of 0.838. When the scaled stage rotor and stator tip clearances were doubled, the stage achieved a pressure ratio of 1.413, efficiency of 0.799, and surge margin of 16.0% at the design flowrate. The peak stage efficiency at design speed was 0.825 with the increased clearance. Increased prewhirl lowered the stage pressure ratio as expected. Stage efficiency was maintained with ten degrees of increased prewhirl and then decreased substantially with ten additional degrees of reset. Author

N78-12082*# Pratt and Whitney Aircraft Group, West Palm Beach, Fla. Government Products Div.
EVALUATION OF A LOW ASPECT RATIO SMALL AXIAL COMPRESSOR STAGE, VOLUME 2 Final Report
C. W. Sawyer, III Nov. 1977 222 p refs
(Contract NAS3-19424)
(NASA-CR-135241; PWA-FR-8499-Vol-2) Avail: NTIS HC A10/MF A01 CSCL 21E

For abstract, see N78-12081.

N78-12083*# AiResearch Mfg. Co., Phoenix, Ariz.
COST/BENEFIT ANALYSIS OF ADVANCED MATERIAL TECHNOLOGIES FOR SMALL AIRCRAFT TURBINE ENGINES
D. H. Comey Sep. 1977 68 p refs
(Contract NAS3-20073)
(NASA-CR-135265; AiResearch-21-2391) Avail: NTIS HC A04/MF A01 CSCL 21E

Cost/benefit studies were conducted on ten advanced material technologies applicable to small aircraft gas turbine engines to be produced in the 1985 time frame. The cost/benefit studies were applied to a two engine, business-type jet aircraft in the 6800- to 9100-Kg (15,000- to 20,000-lb) gross weight class. The new material technologies are intended to provide improvements in the areas of high-pressure turbine rotor components, high-pressure turbine rotor components, high-pressure turbine stator airfoils, and static structural components. The cost/benefit of each technology is presented in terms of relative value, which is defined as a change in life cycle cost times probability of success divided by development cost. Technologies showing the most promising cost/benefits based on relative value are uncooled single crystal MAR-M 247 turbine blades, cooled DS MAR-M 247 turbine blades, and cooled ODS 'M'CrAl laminate turbine stator vanes. Author

N78-12084*# National Aeronautics and Space Administration, Washington, D. C.
REDUCING SECONDARY LOSSES BY BLOWING COLD AIR IN A TURBINE
W. Koschel Nov. 1977 27 p refs Transl. into ENGLISH of conf. paper from Inst. for Jet Propulsion and Turbomachines, Rheinisch-Westfaelische Tech. Hochschule, Aachen Presented at 9th DGLR Jahrestagung, Munich, 14-16 Sep. 1976 p 1-23 Original language document was announced as A76-16558 Transl. by Kanner (Leo) Associates, Redwood City, Calif.
(Contract NASw-2790)
(NASA-TM-75185; Paper-76-164) Avail: NTIS HC A03/MF A01 CSCL 21E

Local blowing on the profile suction side of the turbine guide wheel blades can be effective in preventing the propagation of secondary flows that is, the transport of casing and hub boundary

layers by pressure gradients. Some preliminary results on how the blowing should be accomplished in order to influence the secondary flows in the desired manner are given. The effectiveness of blowing is demonstrated. Blowing is also seen to be more effective than using boundary layer slots as far as diminishing losses in the rim zones is concerned. Author

N78-12085*# National Aeronautics and Space Administration, Washington, D. C.

NEW MATERIALS FOR HIGH TEMPERATURE TURBINES; ONERA'S DS COMPOSITES CONFRONTED WITH BLADE PROBLEMS

H. Bibring Oct. 1977 22 p refs Transl. into ENGLISH from High Temperature Problems in Gas Turbine Engines, Ankara, AGARD conf. preprint no. 229, 1977 p 20-1 - 20-10 Presented at High Temp. Probl. in Gas Turbine Eng., Ankara, 19-23 Sept. 1977 Original language document was announced as A77-50992 Transl. by Kanner (Leo) Associates, Redwood City, Calif. Original doc. prep. by ONERA, Paris (France)
(Contract NASw-2790)
(NASA-TM-75216) Avail: NTIS HC A02/MF A01 CSCL 21E

ONERA's refractory DS composites were cited as materials required for use in advanced aircraft turbines, operating at high temperatures. These materials were found to be reliable in the construction of turbine blades. Requirements for a blade material in aircraft turbines operating at higher temperatures were compared with the actual performance as found in COTAC DS composite testing. The structure and properties of the more fully developed 74 and 741 types were specified. High temperature structural stability, impact of thermal and mechanical fatigue, oxidation resistance and coating capability were thoroughly evaluated. The problem of cooling passages in DS eutectic blades is also outlined. Author

N78-12086*# National Aeronautics and Space Administration, Washington, D. C.

PROTECTION OF COOLED BLADES OF COMPLEX INTERNAL STRUCTURE

P. Glamiche Oct. 1977 22 p refs Transl. into ENGLISH from AGARD Conf. Preprint No. 229 Presented at Conf. on High Temp. Probl. in Gas Turbine Engines, Ankara, 19-23 Sep. 1977; sponsored by AGARD Transl. by Kanner (Leo) Associates, Redwood City, Calif. Original doc. prep. by Natl. Inst. of Aerospace Studies and Res.
(Contract NASw-2790)
(NASA-TM-75217; AGARD-CP-229) Avail: NTIS HC A02/MF A01 CSCL 21E

The problem of general protection of cooled blades of complex internal structure was solved by a method called SF technique which makes possible the protection of both external and internal surfaces, as well as those of the orifices of cooling air, whatever their diameter. The SF method is most often applied in the case of pack process, at controlled or high activity; it can be of use on previously uncoated parts, but also on pieces already coated by a thermochemical, chemical or PVD method. The respective thickness of external and internal coatings may be precisely predetermined, no parasitic particle being liable to remain inside the parts after application of the protecting treatment. Results obtained to date by application of this method are illustrated by the presentation and examination of a various selection of advanced turbo engines. Author

N78-12087# Pratt and Whitney Aircraft Group, East Hartford, Conn.

ENGINEERING SUMMARY OF POWERPLANT ICING TECHNICAL DATA Final Report

G. D. Pfeifer and G. P. Maier Jul. 1977 211 p refs
(Contract DOT-FA76WA-3840)
(AD-A045087; PWA-5522; FAA-RD-77-76) Avail: NTIS HC A10/MF A01 CSCL 21/5

The aircraft engine design is provided with appropriate background information, and with sufficient equations and design charts, and instructions regarding their use, such that a logical approach to the complex problem of engine ice prevention can be established and understood. A technical data review and discussion of current practices of test verification procedures are presented to give visibility to those areas of atmospheric icing phenomena which can be realistically simulated by experiments, and to point out those areas in which more research is needed. Author

N78-12088# Pratt and Whitney Aircraft Group, East Hartford, Conn.

STUDY TO IMPROVE TURBINE ENGINE ROTOR BLADE CONTAINMENT Final Report, Aug. 1976 - Aug. 1977

K. F. Heerman, K. R. McClure, and R. H. Eriksson Aug. 1977 55 p refs
(Contract DOT-FATQWA-3857)
(AD-A045314; PWA-5551; FAA-RD-77-100) Avail: NTIS HC A04/MF A01 CSCL 21/5

An engineering study on a large turbofan engine was conducted to: (1) accurately estimate the engine weight increase and design criteria necessary to contain equivalent disk fragments resulting from a rotor failure, (2) evaluate forward containment for tip fragments of fan blades, (3) identify critical structural components and loads for the loss of an equivalent fan disk fragment through analysis of the rotor/frame transient dynamic response. The fragments studied for engine containment were disk fragments with energy equivalent to 2 adjacent blades and an included disk serration, and 4 adjacent blades and 3 included disk serrations. The forward containment study was made to determine the additional weight required to contain or deflect turbofan engine fan blade tip fragments up to 30 degrees forward of the plane of rotation, as measured from the axis of rotation. Results indicated significant weight increases for the engine in order to contain the equivalent disk fragments of 2 blades with an included disk serration and 4 blades with 3 included disk serrations. The total resultant engine weight increase for the two blade fragment is 367 pounds and for the four blade fragment is 682 pounds. Author

N78-12089*# Vought Corp., Hampton, Va. Technical Center.

ENGINEL: A SINGLE ROTOR TURBOJET ENGINE CYCLE MATCH PERFORMANCE PROGRAM

W. A. Lovell Oct. 1977 63 p refs
(Contract NAS1-13500)
(NASA-CR-145267) Avail: NTIS HC A04/MF A01 CSCL 21E

ENGINEL is a computer program which was developed to generate the design and off-design performance of a single rotor turbojet engine with or without afterburning using a cycle match procedure. It is capable of producing engine performance over a wide range of altitudes and Mach numbers. The flexibility, of operating with a variable geometry turbine, for improved off-design fuel consumption or with a fixed geometry turbine as in conventional turbojets, has been incorporated. In addition, the option of generation engine performance with JP4, liquid hydrogen or methane as fuel is provided. Author

N78-12090# Naval Air Propulsion Test Center, Trenton, N.J. Propulsion Technology and Project Engineering Dept.

TURBINE ENGINE DIAGNOSTICS DEVELOPMENT REPORT, PHASE 3 Final Report

R. T. Lazarick, P. Worobel, J. E. Zoog, R. E. Oberndorfer, and C. N. Shen Jan. 1977 155 p refs
(WF41433301)
(AD-A044471; NAPTC-PE-88) Avail: NTIS HC A08/MF A01 CSCL 21/5

Turbine engine diagnostic development was continued in a number of hardware and software areas. New development and/or evaluation work was done on a turbine inlet temperature sensor, Ferrograph iron-in-oil monitor, and vibrating cylinder pressure transducer. Software work included investigation of data smoothing techniques, study of multiple fault gas path analysis applied to TF30-P-408 engine data, development of an advanced variable geometry engine cycle deck, and sensitivity study of the TEDD program. Author (GRA)

N78-12091# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Systems and Logistics.

AN INVESTIGATION OF THE RELATIONSHIP OF SECTION PRODUCTION COSTS TO TOTAL PRODUCTION COSTS OF GAS TURBINE ENGINES M.S. Thesis

James K. Greene and Arthur E. Stark Jun. 1977 105 p refs
(AD-A044172; AFIT-LSSR-34-77A) Avail: NTIS HC A06/MF A01 CSCL 21/5

The Air Force Aero Propulsion Laboratory is currently exploring techniques which may be used to estimate the production costs of gas turbine engines in the conceptual and validation phases of system acquisition. This study served as a part of that on-going exploration and was designed to investigate the relationship of engine section production costs to total production costs of gas turbine engines. The results of this research include the following findings: (1) correlation analysis provides an effective technique for determining those relationships; (2) among engine sections, costs of the high pressure turbine and compressor sections demonstrated the highest consistent correlations with total engine production cost; (3) regression analysis using the costs of high pressure turbine and compressor sections appears to hold promise for estimating total engine production cost; (4) a modification of the industrial engineering approach in which a cost estimate of the high pressure turbine section would be 'built up' and used, in turn, to estimate production costs of the complete engine also appears to hold promise; and (5) engine cost data presently collected and retained within the Air Force appear inadequate for estimating studies utilizing the production costs of engine parts, assemblies, and sections. Author (GRA)

N78-12092# Pratt and Whitney Aircraft, West Palm Beach, Fla. Government Products Div.

CUMULATIVE DAMAGE FRACTURE MECHANICS AT ELEVATED TEMPERATURES Final Report, 1 May - 1 Nov. 1976

David L. Sims, Charles G. Annis, Jr., and Raymond M. Wallace Apr. 1977 64 p refs

(Contract F33615-75-C-5097)

(AD-A044420; FR-8101; AFML-TR-76-176) Avail: NTIS HC A04/MF A01 CSCL 21/5

The interpolative hyperbolic sine model for mission-mix crack growth was used to predict the propagation histories and cycles-to-failure for two specimen geometries (compact tension and surface crack) at two temperatures (1000 F and 1200 F). Results were encouraging with an average prediction error of less than 15%. Author (GRA)

N78-12093# General Applied Science Labs., Inc., Westbury, N. Y.

DEVELOPMENT OF A CATALYTIC COMBUSTOR FUEL/AIR CARBURETION SYSTEM Final Report, 1 May 1976 - 3 Feb. 1977

Gerald Roffe Mar. 1977 70 p refs

(Contract F33615-76-C-2070; AF Proj. 3048)

(AD-A044063; GASL-TR-242) Avail: NTIS HC A04/MF A01 CSCL 21/5

Candidate fuel/air carburetion systems were screened to determine their ability to produce a uniform mixture of Jet A fuel air. Pressure, air blast and air-assist atomization techniques were examined. The air-assist fuel injection scheme was selected as most appropriate and was modified by the use of a variable angle swirl generator to produce acceptably flat fuel and velocity profiles at the system exit. The device was tested over a range of air velocity, inlet pressure, inlet temperature and fuel/air ratio. Profiles of velocity, fuel concentration and degree of vaporization were measured at the exit plane and at an intermediate station 75% of the distance between the injector and the exit. Velocity profiles were found to have a standard deviation of only 10.5% from the ideal case, while the average deviation of the fuel concentration profile was 8.3% from ideal. Measurements indicated that the complete vaporization was achieved prior to the system outlet plane. Two units of the tested system were fabricated and delivered to the Air Force Aero Propulsion Laboratory. Author (GRA)

N78-12094# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Systems and Logistics.

AN ANALYSIS OF INFORMATION SOURCES FOR THE ESTIMATION OF LIFE CYCLE OPERATING AND MAINTENANCE COSTS OF TURBINE ENGINES

Michael D. Baker and Bruce B. Johnston Jun. 1977 170 p refs

(AD-A044082; AFIT-SLSR-11-77A) Avail: NTIS HC A08/MF A01 CSCL 21/5

This study is an attempt to locate, analyze and evaluate data bases which contain operation and support (O and S) cost data for aircraft engines. The search for these data bases was primarily conducted at Headquarters, Air Force Logistics Command. The study focused upon the Increase Reliability of Systems (IROS) data base, the HO36B DOD Cost and Production Report, the AFM 400-1 actuarial data system, the cost and planning factors in AFR 173-10, aerospace ground equipment data located in the Tables of Allowance, and Component Improvement Program data located at the Deputy for Propulsion, Aeronautical Systems Division. The study of these data bases led to the conclusion that data bases in the Air Force are not well designed for cost data collection and that many data bases are necessary to obtain the total operation and support cost of an aircraft engine. Author (GRA)

N78-12095# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Systems and Logistics.

AN IDENTIFICATION AND CHARACTERIZATION OF COST MODELS/TECHNIQUES USED BY AIR FORCE LOGISTICS COMMAND TO ESTIMATE JET ENGINE OPERATION AND SUPPORT COSTS M.S. Thesis

George H. Davidson and Raymond E. Griffiths Jun. 1977 190 p refs

(AD-A044083; AFIT-LSSR-01-77A) Avail: NTIS HC A09/MF A01 CSCL 14/1

The Life Cycle Cost (LCC) for jet engines includes the cost of design and development, test and evaluation, production, operation and support, and where applicable, disposal. Although only a small portion of the total LCC is incurred prior to production, the decisions made up to that point determine most of the total engine LCC. It is during this early design phase that there is insufficient operational information on the new engine to permit prediction of costs incurred during the operation and support phase of LCC. Estimation of LCC is further hindered by the absence of knowledge about techniques which could be used during engine design. This research involved a systematic investigation of the models and techniques used by the Air Force Logistics Command to estimate jet engine operation and support cost. These models and techniques are used in the areas of requirements determination for recoverable spares, engine overhaul, and total annual support-cost estimates for recoverable items. They are characterized to allow a determination as to their applicability for use during engine design. Author (GRA)

N78-12096# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ECONOMIC PROBLEMS OF DETERMINING THE DURABILITY OF AIRCRAFT ENGINES

V. K. Vashchenko and G. M. Derkach 31 Jan. 1977 19 p Transl. into ENGLISH from Standarty i Kachestvo (Moscow), no. 6, Jun. 1969 p 56-58

(AD-A044672; FTD-ID(RS)I-0073-77) Avail: NTIS HC A02/MF A01 CSCL 01/3

Increasing the service life, reliability and maintainability of aircraft engines is a complex problem which involves design, technological, operational and economic problems. Discussed is the problem of establishing the optimum number of major overhauls of derivative engines with different service lives in the design stage. GRA

08 AIRCRAFT STABILITY AND CONTROL

Includes aircraft handling qualities; piloting; flight controls; and autopilots.

N78-12097 Kansas Univ., Lawrence.

AN OPTIMAL AUTOMATIC FLIGHT CONTROL SYSTEM FOR THE BEECH MODEL 99 SEPARATE SURFACES AIRLINER Ph.D. Thesis

Leland Robert Johnson, Jr. 1976 199 p

Avail: Univ. Microfilms Order No. 77-17761

Automated flight control system optimality in piloted aircraft was considered. Optimality is determined by a subjective balance in the mind of the pilot between his opinion of how well the aircraft follows commanded inputs, and the degree to which

external disturbances are damped. This balance is different for each pilot, and the optimal control strategy should allow the operator to program the relative significance of these two objectives in the closed loop system. Such a control strategy can not be directly implied by a set of desired poles and zeroes. Instead, some combination of these two control objectives will create the entire system configuration. The mathematics for the two control objectives were prepared using quadratic cost functions. Results were applied to the Beech Model 99 separate surfaces airliner. Dissert. Abstr.

N78-12098# Tokyo Univ. (Japan). Dept. of Aeronautics.
A NEW INTERPRETATION OF THE BACKSIDE PARAMETER IN THE AIRPLANE FLIGHT-PATH CONTROL
Kanichiro Kato and Joji Sato 28 Mar. 1977 39 p refs Backup document for AIAA Synoptic, "The Backside Parameter Viewed from Optimal Control", scheduled for publication in Journal of Aircraft in Feb. 1978
Avail: NTIS HC A03/MF A01

Longitudinal flight path control is discussed for conventional airplanes from the control theory viewpoint. Pilot control defined as minimizing quadratic integral criteria led to the empirically asserted piloting technique that the flight path should be controlled by the elevator rather than by the throttle. Simplified analysis in terms of Wiener filter formulation revealed analytically the basic effect of the backside parameter on flight path control by the elevator including the effect of the pilot's efforts to correct the aircraft deviations due to the vertical gust. This was also substantiated through the more detailed analysis in terms of exact regulator problem formulation. Author

N78-12099*# IBM Federal Systems Div., Houston, Texas.
FLIGHT DESIGN SYSTEM REQUIREMENTS EVALUATION PROGRAM Final Report
R. A. Folk 7 Oct. 1977 16 p refs
(Contract NAS9-14350)
(NASA-CR-151531) Avail: NTIS HC A02/MF A01 CSCL 01C

Flight planning requirements were analyzed and a computer system architecture was defined. An evaluation method of the proposed flight design system is also included. B.B.

N78-12100*# National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Center, Edwards, Calif.
PHUGOID CHARACTERISTICS OF A YF-12 AIRPLANE WITH VARIABLE-GEOMETRY INLETS OBTAINED IN FLIGHT TESTS AT A MACH NUMBER OF 2.9
Bruce G. Powers Dec. 1977 45 p refs
(NASA-TP-1107; H-953) Avail: NTIS HC A03/MF A01 CSCL 01C

Flight tests were conducted with the YF-12 airplane to examine the airplane's longitudinal characteristics at a Mach number of approximately 2.9. Phugoid oscillations as well as short period pulses were analyzed with the variable geometry engine inlets in the fixed and the automatic configurations. Stability and control derivatives for the velocity and altitude degrees of freedom and the standard short period derivatives were obtained. Inlet bypass door position was successfully used to represent the total inlet system, and the effect of the inlets on the velocity and altitude derivatives was determined. The phugoid mode of the basic airplane (fixed inlet configuration) had neutral damping, and the height mode was stable. With the addition of the inlets in the automatic configuration, the phugoid mode was slightly divergent and the height mode was divergent with a time to double amplitude of about 114 seconds. The results of the derivative estimation indicated that the change in the height mode characteristics was primarily the result of the change in the longitudinal force derivative with respect to velocity. Author

N78-12101# McDonnell-Douglas Astronautics Co., St. Louis, Mo.
THE USAF STABILITY AND CONTROL DIGITAL DATCOM. VOLUME 2: IMPLEMENTATION OF DATCOM METHODS Final Report, Mar. 1975 - Mar. 1976
John E. Williams and Steven R. Vukelich Wright-Patterson AFB, Ohio AFFDL Nov. 1976 515 p refs Supersedes AFFDL-TR-73-23 and AFFDL-TR-74-68 2 Vol.
(Contract F33615-75-C-3043)
(AD-A045172; AFFDL-TR-76-45-Vol-2; AFFDL-TR-73-23; AFFDL-TR-74-68) Avail: NTIS HC A22/MF A01 CSCL 09/2

This report describes a digital computer program that calculates static stability, high lift and control, and dynamic derivative characteristics using the methods contained in the USAF Stability and Control Datcom (revised January 1974). Configuration geometry, attitude, and Mach range capabilities are consistent with those accommodated by the Datcom. The program contains a trim option that computes control deflections and aerodynamic increments for vehicle trim at subsonic Mach numbers. Volume I is the user's manual and presents program capabilities, input and output characteristics, and example problems. Volume II describes program implementation of Datcom methods. Volume III is the installation manual which defines program implementation requirements and provides a program listing. The program is written in ANS Fortran IV. The primary deviations from standard Fortran are Namelist input and certain statements required by the CDC compilers. Core requirements have been minimized by data packing and the use of overlays. User oriented features of the program include minimized input requirements, input error analysis, and various options for application flexibility. GRA

N78-12102# McDonnell-Douglas Astronautics Co., St. Louis, Mo.
THE USAF STABILITY AND CONTROL DIGITAL DATCOM. VOLUME 1: USERS MANUAL Final Report, Mar. 1975 - Mar. 1976
John E. Williams and Steven R. Vukelich Nov. 1976 304 p refs Supersedes AFFDL-TR-73-23 and AFFDL-TR-74-68
(Contract F33615-75-C-3043)
(AD-A045171; AFFDL-TR-76-45-Vol-1; AFFDL-TR-73-23; AFFDL-TR-74-68) Avail: NTIS HC A14/MF A01 CSCL 09/2

This report, 'The USAF Stability and Control Digital Datcom', describes the computer program that calculates static stability, high lift and control, and dynamic derivative characteristics using the methods contained in sections 4 through 7 of the USAF Stability and Control Datcom (revised January 1974). The report consists of the following three volumes: Volume I, Users Manual, Volume II, Implementation of Datcom Methods, and Volume III, Installation Manual. A complete listing of the program is in Volume III. GRA

09 RESEARCH AND SUPPORT FACILITIES (AIR)

Includes airports, hangars and runways; aircraft repair and overhaul facilities; wind tunnels; shock tube facilities; and engine test blocks.

For related information see also *14 Ground Support Systems and Facilities (Space).*

N78-12103 Old Dominion Univ., Norfolk, Va.
EVALUATION OF HYDROGEN AS A CRYOGENIC WIND TUNNEL TEST GAS Ph.D. Thesis
Richard Carl Haut, II 1977 160 p
Avail: Univ. Microfilms Order No. 77-17259

A theoretical analysis of the properties of hydrogen was made to determine the suitability of hydrogen as a cryogenic wind tunnel test gas. By using cryogenic hydrogen as the wind tunnel test gas, a significant increase in the test Reynolds number is achieved without increasing the aerodynamic loads. Nondimensional ratios used to describe various flow situations in hydrogen determined that cryogenic hydrogen is unacceptable as a wind tunnel test gas in a compressible flow situation. At low Mach numbers, however, in the incompressible flow regime, cryogenic hydrogen is acceptable. Hydrogen properties and fan drive-power requirements related to a hydrogen wind tunnel were also examined. Dissert. Abstr.

N78-12104 California Univ., Berkeley.
UNCERTAINTIES IN AIRPORT COST ANALYSIS AND THEIR EFFECT ON SITE SELECTION Ph.D. Thesis
Tore Knudsen 1976 262 p
Avail: Univ. Microfilms Order No. 77-15741

Uncertainty distributions for actual costs of airport projects were derived on a basis of empirical data. The analysis of uncertainties was carried out by studying the ratio, R, of actual cost to estimated cost for a number of airport projects. The distribution of R was found to be approximately log.-normal and the empirical results indicated considerable bias toward underestimation. Methods developed, were applied to the the problem of location of a new major airport in the Oslo region in Norway. During the decision process, major emphasis was put on the differences in the cost estimates for the different sites. In view of the results arrived, very little confidence should be put on the magnitude of these estimated cost differences.

Dissert. Abstr.

N78-12105*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

OPERATIONAL EXPERIENCE IN THE LANGLEY EXPANSION TUBE WITH VARIOUS TEST GASES

Charles G. Miller 13 May 1977 3 p Presented at AIAA 9th Aerodyn. Testing Conf., Arlington, Tex., 7-9 Jun. 1976 Backup document for AIAA Synoptic scheduled for publication in AIAA Journal in Feb. 1978

(NASA-TM-X-74945) Avail: NTIS HC A02/MF A01 CSCL 14B

A resume' of operating experiences with the Langley Expansion Tube is presented. The driver gas was unheated helium at a nominal pressure of 5000 psi and the majority of the data presented are for air and carbon dioxide test gases. The primary purpose of these data is to illustrate the effects of various parameters on quasi-steady test flow duration, as well as free stream and post-normal shock flow conditions. The discussion shows that the Langley Expansion Tube is an operational facility capable of producing good quality, highly repeatable, quasi-steady flow for test times sufficient to establish flow about blunt axisymmetric and two-dimensional models. Author

N78-12106*# Pennsylvania State Univ., Middletown.

SLOTTED TEST SECTION DYNAMICS OF THE NTF

George Gumas 1 Dec. 1977 34 p refs

(Grant NsG-1457)

(NASA-CR-155266; Rept-1) Avail: NTIS HC A03/MF A01 CSCL 14B

A dynamic model of the National Transonic Facility (NTF) section and plenum chamber was developed. The model serves as a means for determining the dynamic performance of the NTF and the subsequent design of optimal control configurations, and is of one dimensional flow type as to facilitate computer simulation. The model allows for the simulation of the effects of test section blockage, boundary layer losses, slot flow required for supersonic flow generation, reentry flap position, and auxiliary plenum suction. Author

N78-12107# Naval Air Propulsion Test Center, Trenton, N.J. Propulsion Technology and Project Engineering Dept.

EVALUATION OF AN AUTOMATED SMOKE ABATEMENT SYSTEM FOR JET ENGINE TEST CELLS Final Report

A. F. Klarman Jul. 1977 28 p refs

(AD-A044587; NAPTC-PE-108) Avail: NTIS HC A03/MF A01 CSCL 21/5

An Automated Smoke Abatement System (ASAS) which injects a smoke abatement fuel additive into the fuel system of a gas turbine engine was developed for reducing test cell exhaust stack plume opacity caused by engine operation. The ASAS contains three major components: (a) transmissometer to monitor plume opacity, (b) logic/control unit which determined if opacity exceeds the standard, and (c) variable speed pump which injects the optimum quantity of the smoke abatement additive. The difference between the plume opacity and standard, regulates the speed of the pump and quantity of additive injected. The System maintained test cell plume opacity to a visual opacity of 20 percent or less during evaluation tests at two Naval Air Rework Facilities (NARF's). It is recommended that the ASAS be used to control plume opacity from those engines compatible with smoke abatement additives. Author (GRA)

N78-12108# Air Force Academy, Colo.

A VIBRATIONAL ANALYSIS OF THE FECKER INERTIAL TEST TABLE

G. Douglas Evans Aug. 1977 26 p refs

(AF Proj. 2304)

(AD-A044826; FJSRL-TR-77-0014) Avail: NTIS HC A03/MF A01 CSCL 17/7

The Inertial Guidance Research Division of the Frank J. Seiler Research Laboratory at the USAF Academy employs a Fecker Inertial Test Table for use in inertial instrument testing. The test table is mounted on a seismic isolation pad (iso-pad) to provide a motionless test environment. Sensors on the iso-pad detect seismic activity of the pad and provide motion correction signals to actuators through a feedback system. The actuators keep the iso-pad free of motion due to external disturbances. The iso-pad motion correction system rolls off above 20 Hz to avoid actuating the pad at or near its natural resonant frequencies of 59, 65, and 67 Hz, thus avoiding instabilities. A DC-20 Hz motion-correction frequency band is also adequate for the inertial instrument tests conducted by the Inertial Guidance Research Laboratory. The Inertial Test Table is investigated for natural resonant frequencies within the 20-50 Hz range. A strong resonant peak occurs at 22 Hz in both the vertical and horizontal modes. The rotational resonant peak occurs at 34 Hz. Extensive alterations to the test table structure caused no changes in amplitude or frequency of the resonances. GRA

N78-12109# Air Force Human Resources Lab., Williams AFB, Ariz. Flying Training Div.

PROCEEDINGS OF THE 1977 IMAGE CONFERENCE

May 1977 316 p refs Conf. held at Williams AFB, Ariz., 17-18 May 1977

(AD-A044582) Avail: NTIS HC A14/MF A01 CSCL 14/2

The 1977 Innovative Modeling and Advanced Generation of Environments (IMAGE) Conference is the first conference specifically concerned with the imagery produced by computer generated visual systems relative to flight simulation. The purpose of the conference is to promote an exchange of information and inspire investigations into areas of needed flying training research. With the increasing number of real-time computer generated visual simulators in the field, it is necessary to expand communications among the user organizations and create a forum to present relevant issues. Pertinent topics include but are not limited to: efficient and effective modeling techniques; environmental data base design and structure; psychological determination of visual cue requirements; and software/hardware developments directly resulting in an expansion of image capability and/or utility. GRA

12 ASTRONAUTICS (GENERAL)

For extraterrestrial exploration see *91 Lunar and Planetary Exploration.*

N78-12110*# Hudson Inst., Inc., Croton-on-Hudson, N. Y.

LONG-TERM PROSPECTS FOR DEVELOPMENTS IN SPACE: A SCENARIO APPROACH Final Report

William M. Brown and Herman Kahn 30 Oct. 1977 302 p refs

(Contract NASw-2924)

(NASA-CR-156837; HI-2638-RR) Avail: NTIS HC A04/MF A01 CSCL 22A

Long-term plans for future NASA programs are reported, and some of the following topics are discussed in detail: (1) systematic formulation of space scenarios; (2) the basic international context; (3) potential 21st century space developments; (4) space vehicle developments; and (5) future exploration. B.B.

N78-12111*# National Aeronautics and Space Administration, Washington, D. C.

ARIADNE IS LESS COSTLY THAN THE SPACE SHUTTLE

Pierre Langereux Oct. 1977 7 p Transl. into ENGLISH from Air Cosmos (France), no. 685, 24 Sep. 1977 p 41 and 43 Transl. by Transemantics, Inc., Washington, D. C.

(Contract NASw-2792)

(NASA-TM-75057) Avail: NTIS HC A02/MF A01 CSCL 22A

'Ariadne', the European rocket, was found to be less costly than the American space shuttle, judging by the price proposals

sent to Intelsat for the orbiting of its three latest telecommunications satellites in the Intelsat 5 series. The 'Ariadne' is being offered by the ESA and CNES at a ceiling price of $20 million, while the shuttle is priced by NASA at $22.5 million under the same condition. Neither the U. S. nor ESA have endorsed these prices officially. They are being presented as estimates. The 'Ariadne' has a ceiling price, which can only be adjusted downwards, if need be. The launching prices of both of these spacecraft do not include the cost of adapting the Intelsat 5 satellites, designed for the Atlas Centaur rocket. Author

N78-12112*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
IN-SPACE PRODUCTION OF LARGE SPACE SYSTEMS FROM EXTRATERRESTRIAL MATERIALS: A PROGRAM IMPLEMENTATION MODEL
Georg F. VonTiesenhausen Oct. 1977 50 p refs
(NASA-TM-78143) Avail: NTIS HC A03/MF A01 CSCL 22A

A program implementation model is presented which covers the in-space construction of certain large space systems from extraterrestrial materials. The model includes descriptions of major program elements and subelements and their operational requirements and technology readiness requirements. It provides a structure for future analysis and development. Author

13 ASTRODYNAMICS

Includes powered and free-flight trajectories; and orbit and launching dynamics.

N78-12113*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
AN INTRODUCTION TO ORBIT DYNAMICS AND ITS APPLICATION TO SATELLITE-BASED EARTH MONITORING SYSTEMS
David R. Brooks Nov. 1977 85 p refs
(NASA-RP-1009; L-11710) Avail: NTIS HC A05/MF A01 CSCL 22A

The long term behavior of satellites is studied at a level of complexity suitable for the initial planning phases of earth monitoring missions. First-order perturbation theory is used to describe in detail the basic orbit dynamics of satellite motion around the earth and relative to the sun. Surface coverage capabilities of satellite orbits are examined. Several examples of simulated observation and monitoring missions are given to illustrate representative applications of the theory. The examples stress the need for devising ways of maximizing total mission output in order to make the best possible use of the resultant data base as input to those large-scale, long-term earth monitoring activities which can best justify the use of satellite systems. Author

N78-12114# Naval Surface Weapons Center, White Oak, Md. Advanced Weapons Dept.
A PROGRAM FOR COMPUTING STEADY INVISCID THREE-DIMENSIONAL SUPERSONIC FLOW ON REENTRY VEHICLES. VOLUME 2: USERS MANUAL
J. M. Solomon, M. Ciment, R. E. Ferguson, J. B. Bell, and A. B. Wardlaw, Jr. 20 May 1977 100 p refs
(ZF32303001)
(AD-A044544; NSWC/WOL/TR-77-32-Vol-2) Avail: NTIS HC A05/MF A01 CSCL 16/3

A comprehensive computational procedure is presented for predicting the supersonic region of the flow field on advanced reentry vehicle shapes in steady flight at pitch and yaw. The procedure utilizes explicit second order accurate finite difference methods applied to the conservation law form of the steady inviscid flow equations. Improved numerical methods are used at the body surface and the bow shock wave. Provisions for treating body geometries with discontinuous slopes are also included. Either perfect gas or real gas equilibrium thermodynamic properties can be used. The computational procedure is implemented as a FORTRAN computer code which provides a practicable representation of the inviscid flow field and the resulting aerodynamic force and moment on the vehicle. This volume contains detailed instructions for operating the code and interpreting the output results. GRA

14 GROUND SUPPORT SYSTEMS AND FACILITIES (SPACE)

Includes launch complexes, research and production facilities; ground support equipment, mobile transporters; and simulators.

For related information see also *09 Research Support Facilities (Air)*.

No abstracts in this category.

15 LAUNCH VEHICLES AND SPACE VEHICLES

Includes boosters; manned orbital laboratories; reusable vehicles; and space stations.

N78-12115# Committee on Science and Technology (U. S. House).
SEASAT: COST, PERFORMANCE AND SCHEDULE REVIEW
Washington GPO 1977 35 p Rept. for Subcomm. on Space Sci. and Applications of the Comm. on Sci. and Technol., 95th Congr., 1st Sess., Oct. 1977
(GPO-96-276) Avail: Subcomm. on Space Sci. and Applications

The SEASAT-A spacecraft, its instrumentation, and data acquisition capabilities are described, as well as follow-on activities and recommended future activities. Major issues discussed include cost factors, user involvement, and program scheduling. A.R.H.

N78-12116*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
SOLAR POWER SATELLITE: CONCEPT EVALUATION. ACTIVITIES REPORT. VOLUME 1: SUMMARY. VOLUME 2: DETAILED REPORT Activities Report, Jul. 1976 - Jun. 1977
Jul. 1977 130 p
(NASA-TM-74944; JSC-12973-Vol-1; JSC-12973-Vol-2) Avail: NTIS HC A07/MF A01 CSCL 10B

The Johnson Space Center Systems Definition effort from July 1976 to June 1977 presents comparative data of various designs of thermal engine and photovoltaic solar power satellite concepts. The major area of the Solar Power Satellite system examined includes solar cells, transportation, rectenna structure, and environmental issues. A summary of results of the 1977 studies is presented. Author

N78-12117* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
STATIC AERODYNAMIC CHARACTERISTICS OF A SINGLE-STAGE-TO-ORBIT VEHICLE WITH LOW PLANFORM LOADING AT MACH NUMBERS FROM 0.3
Delma C. Freeman, Jr. and Roger H. Fournier Nov. 1977 68 p refs
(NASA-TM-74056; L-11797) Avail: NTIS HC A04/MF A01 CSCL 22B

Transonic pressure and wind tunnel studies were performed to determine the longitudinal and lateral aerodynamic characteristics of a single-stage-to-orbit vehicle which utilizes an all metallic, hot structure, thermal protection system resulting in low planform loading. The model was tested over a Mach number range from 0.3 to 4.63 for angles of attack from -4 deg to 32 deg at both 0 deg and 5 deg sideslip. Author

N78-12118# Aerojet Liquid Rocket Co., Sacramento, Calif.
ENGINEERING REVIEW OF THE ASSEMBLY AND PREPARATION OF SOUNDING ROCKETS Final Report, 1 Jul. 1975 - 30 Jun. 1977

Richard W. Johnson and John A. Mattice Jul. 1977 9 p
(Contract F19628-76-C-0038)
(AD-A044771; ALRC-2888FR-01; AFGL-TR-77-0162) Avail: NTIS HC A02/MF A01 CSCL 22/4

Engineering field personnel provide support for launch of twenty-four sounding rockets from five launch sites. Six engineering tasks were performed. Author (GRA)

N78-12119# Aerojet Solid Propulsion Co., Sacramento, Calif.
WEAPON SYSTEM 133B Final Report
10 Aug. 1977 25 p
(Contract F04704-75-C-0038)
(AD-A044819; ASPC-0162-02TR-STM-14W-1) Avail: NTIS HC A02/MF A01 CSCL 21/8

Minuteman III Special Test Missile 14W-1, with Aerojet-supplied Second Stage Motor AA21517 (PQA6-83), was successfully fired from the Western Test Range (WTR) on 16 June 1977. The missile was tested from Launch Facility 21; range zero time was approximately 1900 hr P.d.t. (0200:00.817 hr UTC). Performance of the second stage motor was satisfactory and all measured performance parameters were within model specification limits. The motor ignited satisfactorily and operated for an action time of 65.2 sec. Second stage skirt jettison occurred 16.40 sec after Stage I-II staging. The liquid injection thrust vector control and roll control system performed satisfactorily. Injectant utilization was 101.2 lb. Author (GRA)

N78-12120# Harry Diamond Labs., Adelphi, Md.
SKYNET APPLICATIONS SOFTWARE PACKAGE (SASP) OPERATOR'S AND USER'S HANDBOOK
Walter J. Scott and John R. Hiller Aug. 1977 91 p refs
(AD-A044411; HDL-TR-1817) Avail: NTIS HC A05/MF A01 CSCL 09/2

The objective of the Defense Nuclear Agency sponsored SKYNET program is to develop a methodology for the assessment of satellite vulnerability to system generated electromagnetic pulse (SGEMP) effects from nuclear weapons. The approach includes a study of basic phenomenology and development of cost-effective simulation techniques, as well as improving SGEMP instrumentation and data acquisition and recording techniques. This report presents a new procedure for capturing and processing complex SGEMP transients. The method is incorporated into an SGEMP Transportable Automated Recording System (STARS). It reduces manual data handling significantly (a major source of errors); outputs data as computer compatible magnetic tapes, annotated hard copies, or both; and lessens the manpower requirements for data acquisition and processing. The software implementation, SKYNET Applications Software Package (SASP), is discussed here to provide STARS operators and users with the detailed information needed to effectively utilize the system. A companion volume, the SKYNET Applications Software Package (SASP) Programmer's Handbook, contains detailed summaries of all SASP source codes. GRA

N78-12121# Lincoln Lab., Mass. Inst. of Tech., Lexington.
AN ATTITUDE CONTROL SYSTEM FOR A LARGE GEO-SYNCHRONOUS EARTH-POINTING SATELLITE
Joseph R. Vernau 5 Jul. 1977 47 p refs
(Contract F19628-76-C-0002)
(AD-A044822; TN-1977-30; ESD-TR-77-173) Avail: NTIS HC A03/MF A01 CSCL 22/2

The proposed attitude control system addresses three principal problem areas: (1) Operation within a high disturbance torque environment; (2) The preservation of vehicle attitude in the event that the optical attitude sensors are destroyed by external means; and (3) System operational longevity. Author (GRA)

N78-12122# Boston Coll., Chestnut Hill, Mass.
A SIMULATION STUDY OF A TWELVE DEGREE OF FREEDOM SYSTEM Interim Report
Eugene B. Hartnett Mar. 1977 16 p
(Contract F19628-76-C-0007)
(AD-A044756; Scientific-1; AFGL-TR-77-0061) Avail: NTIS HC A02/MF A01 CSCL 12/1

A twelve degree of freedom model for a missile suspension system was simulated mathematically. The derived equations of motion were solved for missile accelerations and displacements at various driving forces, frequencies, and damping coefficients. The simulation results were validated using measured field data. Author (GRA)

N78-12123# Regis Coll., Weston, Mass.
DEVELOPMENT AND APPLICATION OF ELECTRICAL AND MECHANICAL PROTOTYPE INSTRUMENTS FOR SPACE ENVIRONMENT STUDIES Final Report, 16 Feb. 1975 - 30 Apr. 1977
Mukhtar Ahmed, Peter B. Anderson, William J. Burke, and Frederick J. Rich 31 May 1977 95 p refs
(Contract F19628-75-C-0081)
(AD-A044742; AFGL-TR-77-0119) Avail: NTIS HC A05/MF A01 CSCL 09/3

The objectives of this contract have been adequately realized. The development, calibration and integration of the prototype instrumentation were applied in scientific experiments flown on two AEOLUS rocket payloads, which involved circuit design, printed circuit layouts, electronic density package design, and electronics package design. Analysis and synthesis of flight results involved plasma measurements including bulk ion motions, energy distributions, plasma diagnostic sensors, physical dimensions and location under changing geophysical conditions. Author (GRA)

N78-12124# Army Armament Research and Development Command, Dover, N. J. Large Caliber Weapon Systems Lab.
PANOL SIX DEGREES-OF-FREEDOM SYSTEM ANALYSIS AND USAGE
Eugene M. Friedman Sep. 1977 115 p refs
(AD-A044539; ARLCD-TR-77025) Avail: NTIS HC A06/MF A01 CSCL 19/4

A description is given of the development and execution of a system of computer programs which describe the motion of a projectile in six degrees of freedom. Several versions of PANOL exist which can simulate the flight of a projectile: with body-fixed aerodynamic asymmetry, with mass asymmetry, with a yawsonde on board, or with guidance and steering jets. Author (GRA)

N78-12125# Aerospace Corp., El Segundo, Calif. Ivan A. Getting Labs.
A RATIONAL METHOD FOR DESIGN OF FEEDBACK CONTROL TO LIMIT MISSILE DISPERSION Interim Report
Daniel H. Platus and Julian Wolkovitch 15 Aug. 1977 34 p refs
(Contract F04701-76-C-0077)
(AD-A044850; TR-0077(2240)-4; SAMSO-TR-77-193) Avail: NTIS HC A03/MF A01 CSCL 16/2

A method for the design of feedback control to limit cross-range dispersion of spinning missiles is described. The missile transverse velocity in the cross plane is selected as the cost function, and optimal linear feedbacks are derived that minimize this velocity in the presence of aerodynamic disturbances that cause lift nonaveraging. A closed-form solution is obtained for the open- and closed-loop missile response to simple disturbance moments. Cross-range dispersion control complements control of range error by angle-of-attack control of drag. The resulting two-loop system can control major sources of missile dispersion. Author (GRA)

N78-12126# Lincoln Lab., Mass. Inst. of Tech., Lexington.
ANALYSIS OF FIREPOND IR RCS DATA ON ROCKET MODEL
Bruce A. Francis 18 May 1977 34 p refs
(Contract F19628-76-C-0002; ARPA Order 600)
(AD-A044664; LRP-5; ESD-TR-77-111) Avail: NTIS HC A03/MF A01 CSCL 17/5

Coherent narrowband infrared radar returns from a fixed rotating target were analyzed. The data were taken using the Firepond radar facility with small-aperture transmitting and receiving antennas at a range of 5 km. The amplitude distribution of the returns from the target were compared with those from a spherical mirror. Author (GRA)

16 SPACE TRANSPORTATION

Includes passenger and cargo space transportation e.g., shuttle operations; and rescue techniques.

For related information see also *03 Air Transportation and Safety* and *85 Urban Technology and Transportation.*

N78-12127# Committee on Science and Technology (U. S. House).

SPACE TRANSPORTATION SYSTEM

Washington GPO 1977 654 p refs Hearings before Subcomm. on Space Sci. and Applications of the Comm. on Sci. and Technol., 95th Congr., 1st Sess., No. 19, 17-18 May 1977 (GPO-94-563) Avail: Subcomm. on Space Sci. and Applications

Hearings were held to review the current status of the National Space Transportation System. Testimony was received from representatives of the NASA and the U.S. Air Force. NASA is responsible for the space shuttle development and overall operations and business management; the Air Force is the executive agency of the Dept. of Defense responsible for DOD payloads and establishing launch operations for the space shuttle at Vandenberg Air Force Base. For individual titles, see N78-12128 through N78-12137.

N78-12128*# National Aeronautics and Space Administration, Washington, D. C.

SPACE TRANSPORTATION SYSTEM PAYLOAD STATUS AND REIMBURSEMENT POLICY

John F. Yardley *In* Comm. on Sci. and Technol. (U. S. House) Space Transportation System 1977 p 2-87 refs (For availability see N78-12127 03-16)

Avail: Subcomm. on Space Sci. and Applications CSCL 22A

The status of the Space Transportation System (STS) is reviewed. The management structure and project planning status are discussed, including considerations of STS utilization, payloads, cost assessments, and pricing policy. J.H.

N78-12129# Department of the Air Force, Washington, D.C.

STATEMENT OF DR. KENNETH L. JORDAN, PRINCIPAL DEPUTY ASSISTANT SECRETARY OF THE AIR FORCE FOR RESEARCH AND DEVELOPMENT, ACCOMPANIED BY MAJOR GENERAL EDWIN A. COY, DIRECTOR OF SPACE, DEPUTY CHIEF OF STAFF, RESEARCH AND DEVELOPMENT, USAF; LIEUTENANT COLONEL FRANK A. PAPAROZZI, PLANS AND TECHNOLOGY DIVISION, DIRECTORATE OF SPACE, DEPUTY CHIEF OF STAFF, RESEARCH AND DEVELOPMENT, USAF; AND LIEUTENANT COLONEL JAMES W. RIVERS, JR., PROGRAM ELEMENT MONITOR, SPACE BOOSTERS, DEPUTY CHIEF OF STAFF, R AND D, USAF

In Comm. on Sci. and Technol. (U. S. House) Space Transportation System 1977 p 89-115 (For availability see N78-12127 03-16)

Avail: Subcomm. on Space Sci. and Applications

Air Force participation in the Space Transportation project is summarized. The Interim Upper Stage is now in the validation stage phase of its development, and plans are underway for the Vandenberg AFB ground operations and for shuttle payload transition schedules. J.H.

N78-12130*# National Aeronautics and Space Administration, Washington, D. C.

STATEMENT OF CHESTER M. LEE, DIRECTOR, SPACE TRANSPORTATION SYSTEMS OPERATIONS, NASA, AND PHILLIP E. CULBERTSON, ASSISTANT ADMINISTRATOR OF PLANNING AND PROGRAM INTEGRATION, NASA

In Comm. on Sci. and Technol. (U. S. House) Space Transportation System 1977 p 115-172 refs (For availability see N78-12127 03-16)

Avail: Subcomm. on Space Sci. and Applications CSCL 22A

Payloads for the Space Transportation System 560 flights, particularly the NASA payloads, are discussed. NASA payloads will make up approximately 50% of total payloads in these flights. Proposed Spacelab experiments are listed and discussed; plans for accommodating commercial user payloads are then outlined, including price schedules. J.H.

N78-12131*# National Aeronautics and Space Administration, Washington, D. C.

LETTER TO DON FUQUA ON SPACE SHUTTLE COMMITMENT, 12 APRIL 1977

James C. Fletcher *In* Comm. on Sci. and Technol. (U. S. House) Space Transportation System 1977 p 174-176 (For availability see N78-12127 03-16)

Avail: Subcomm. on Space Sci. and Applications CSCL 22A

NASA budget commitments for the Space Shuttle program are delineated, estimating $6.816 billion (FY 1978 dollars) for the design, development, test and evaluation phase of operations. Current estimates for refurbishment of Orbiters 101 and 102 and procurement of Orbiters 103, 104, and 105 amount to $1.988 billion. Ground support equipment costs are estimated to be an additional $432 million. J.H.

N78-12132*# National Aeronautics and Space Administration, Washington, D. C.

JOINT NASA/USAF STUDY ON SPACE SHUTTLE ORBITER PROCUREMENT AND RELATED ISSUES

In Comm. on Sci. and Technol. (U. S. House) Space Transportation System 1977 p 177-312 (For availability see N78-12127 03-16)

Avail: Subcomm. on Space Sci. and Applications CSCL 22A

The comprehensive data and analyses are provided for decision on the procurement of additional space shuttle orbiters. The decision required is the number of orbiters needed for the national operational fleet, and how additional orbiters should be funded. Author

N78-12133*# National Aeronautics and Space Administration, Washington, D. C.

REPORT ON NASA FIVE-YEAR PLANNING, FISCAL YEARS 1978 THROUGH 1982

Philip E. Culbertson *In* Comm. on Sci. and Technol. (U. S. House) Space Transportation System 1977 p 313-402 refs (For availability see N78-12127 03-16)

Avail: Subcomm. on Space Sci. and Applications CSCL 22A

This plan is NASA's initial description of its projected research and development activities for the years 1978 through 1982. Stated goals are: (1) assurance of U.S. Preeminence in aviation, (2) scientific exploration of the universe, (3) global information services, and (4) permanent U.S. presence in space. The program represents a budget increase in NASA's aeronautical and space research and development of between three and four percent per year in terms of FY 1978 dollars. Author

N78-12134*# National Aeronautics and Space Administration, Washington, D. C.

JOINT DOD/NASA STUDY: CONSOLIDATION OF EXPENDABLE LAUNCH VEHICLES DURING TRANSITION TO THE SPACE TRANSPORTATION SYSTEM

In Comm. on Sci. and Technol. (U. S. House) Space Transportation System 1977 p 403-463 (For availability see N78-12127 03-16)

Avail: Subcomm. on Space Sci. and Applications CSCL 22A

A considerable amount of data is presented which was needed to compare consolidation options. The study shows that there is no clean-cut DOD/NASA advantage for consolidation. However, for DOD uses, the technical advantage of using the Titan III/IUS for the Titan IIIC in the transition era, coupled with a possible cost-push in converting to the Titan III/IUS, warrants serious DOD consideration. Author

N78-12135*# National Aeronautics and Space Administration, Washington, D. C.

SPACE SHUTTLE UTILIZATION

In Comm. on Sci. and Technol. (U. S. House) Space Transportation System 1977 p 469-484 (For availability see N78-12127 03-16)

Avail: Subcomm. on Space Sci. and Applications CSCL 22A

The information and rationale required to assess the level and pattern of space shuttle utilization that best serves the national interest are provided. Comparisons are given for civil program, national total program and Dept. of Defense total program costs. Author

N78-12136*# National Aeronautics and Space Administration, Washington, D. C.
REPORT ON COST/PRICING RELATIONSHIPS FOR THE SPACE SHUTTLE
In Comm. on Sci. and Technol. (U. S. Senate) Space Transportation System 1977 p 587-608 (For availability see N78-12127 03-16)
Avail: Subcomm. on Space Sci. and Applications CSCL 22A

The operations cost for the shuttle is the basis for developing the user charge policy for the system. The policy contains several elements that are significant to the user and to NASA. It will encourage the full use of the system to the benefits of the U.S. The charge policy will encourage early transition from the expendable launch vehicles to the shuttle and this will result in lower user costs for government as well as commercial users. The relationship between the charge policy and the utilization of the shuttle is critical to the economic efficiency of the system. NASA recognizes the challenging a relationship between pricing the cost of using a reusable space system, and the need to make sure it is re-used often. Author

N78-12137*# National Aeronautics and Space Administration, Washington, D. C.
LEGAL ISSUES INHERENT IN SPACE SHUTTLE OPERATIONS
In Comm. on Sci. and Technol. (U. S. Senate) Space Transportation System 1977 p 611-637 refs (For availability see N78-12127 03-16)
Avail: Subcomm. on Space Sci. and Applications CSCL 22A

The legal issues inherent in NASA's proceeding into the day-to-day operations of the space shuttle and other elements of the Space Transportation System are considered in light of the National Aeronautics and Space Act of 1958. Based on this review, it was concluded that there is no immediate need for substantive amendments to that legislation. J.H.

17 SPACECRAFT COMMUNICATIONS, COMMAND AND TRACKING

Includes telemetry; space communications networks; astronavigation; and radio blackout.

For related information see also *04 Aircraft Communications and Navigation* and *32 Communications*.

N78-12138# Aerospace Corp., El Segundo, Calif. Space Sciences Lab.
SOURCE LOCATING PROCEDURE Interim Report
D. C. Pridmore-Brown and L. M. Friesen 15 Jul. 1977 62 p (Contract F04701-76-C-0077)
(AD-A044649; TR-0077(2632)-1; SAMSO-TR-77-137) Avail: NTIS MF A01 CSCL 17/8

A computer program is presented for estimating the location of a target from satellite measurements of its photon emission. The satellite is assumed to have a number of detectors mounted at various orientations which monitor the photon count rates. From these the most probable target location is inferred by a least squares fitting technique. Author (GRA)

18 SPACECRAFT DESIGN, TESTING AND PERFORMANCE

Includes spacecraft thermal and environmental control; and attitude control.

For life support systems see *54 Man/System Technology and Life Support*. For related information see also *05 Aircraft Design, Testing and Performance* and *39 Structural Mechanics*.

N78-12139# Aerospace Corp., El Segundo, Calif. Engineering Science Operations.
THE STRUCTURE OF MULTI-BODY DYNAMICS EQUATIONS Final Report
W. Jerkovsky 1 Jun. 1977 42 p refs
(Contract F04701-76-C-0077)
(AD-A044512; TR-0077(2901-03)-6; SAMSO-TR-77-196)
Avail: NTIS HC A03/MF A01 CSCL 22/2

Several alternative formulations for the dynamics of multi-body systems are described. These alternatives include momentum and velocity formulations with decoupling or coupling of constraints. The presentation of equations is facilitated by the introduction of a path matrix and a reference matrix which describe the topology of the n-body configuration. The final equations of motion are obtained from the equations of motion for a single body via the transformation operator formalism. The equations of motion presented herein are compared with ten n-body dynamics formulations in the spacecraft dyna uics literature. Author (GRA)

19 SPACECRAFT INSTRUMENTATION

For related information see also *06 Aircraft Instrumentation* and *35 Instrumentation and Photography*.

No abstracts in this category.

20 SPACECRAFT PROPULSION AND POWER

Includes main propulsion systems and components e.g., rocket engines; and spacecraft auxiliary power sources.

For related information see also *07 Aircraft Propulsion, 28 Propellants and Fuels*, and *44 Energy Production and Conversion*.

N78-12140*# TRW Defense and Space Systems Group, Redondo Beach, Calif.
ION BEAM PLUME AND EFFLUX CHARACTERIZATION FLIGHT EXPERIMENT STUDY Final Report, 1 Jan.-1 Dec. 1977
J. M. Sellen, Jr., S. Zafran, A. Cole, G. Rosiak, and G. K. Komatsu 1 Dec. 1977 166 p refs
(Contract NAS3-30287)
(NASA-CR-135275) Avail: NTIS HC A08/MF A01 CSCL 21C

A flight experiment and flight experiment package for a shuttle-borne flight test of an 8-cm mercury ion thruster was designed to obtain charged particle and neutral particle material transport data that cannot be obtained in conventional ground based laboratory testing facilities. By the use of both ground and space testing of ion thrusters, the flight worthiness of these ion thrusters, for other spacecraft applications, may be demonstrated. The flight experiment definition for the ion thruster initially defined a broadly ranging series of flight experiments and flight test sensors. From this larger test series and sensor list, an initial flight test configuration was selected with measurements in charged particle material transport, condensible neutral material transport, thruster internal erosion, ion beam neutralization, and ion thrust beam/space plasma electrical equilibration. These measurement areas may all be examined for a seven day shuttle sortie mission and for available test time in the 50 - 100 hour period. Author

N78-12141*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
MONOPROPELLANT THRUSTER EXHAUST PLUME CONTAMINATION MEASUREMENTS
R. K. Baerwald and R. S. Passamaneck 15 Sep. 1977 66 p refs Sponsored in part by the AF
(Contract NAS7-100)
(NASA-CR-155270; JPL-Pub-77-61) Avail: NTIS HC A04/MF A01 CSCL 21H

The potential spacecraft contaminants in the exhaust plume of a 0.89N monopropellant hydrazine thruster were measured in an ultrahigh quartz crystal microbalances located at angles of approximately 0 deg, + 15 deg and + or - 30 deg with respect to the nozzle centerline. The crystal temperatures were controlled such that the mass adhering to the crystal surface at temperatures of from 106 K to 256 K could be measured. Thruster duty cycles of 25 ms on/5 seconds off, 100 ms on/10 seconds off, and 200 ms on/20 seconds off were investigated. The change in contaminant production with thruster life was assessed by subjecting the thruster to a 100,000 pulse aging sequence and comparing the before and after contaminant deposition rates. The results of these tests are summarized, conclusions drawn, and recommendations given. Author

N78-12142# Georgia Inst. of Tech., Atlanta. School of Aerospace Engineering.

APPROXIMATE NONLINEAR ANALYSIS OF SOLID ROCKET MOTORS AND T-BURNERS. VOLUME 1: ANALYSIS AND RESULTS Final Report, Feb. 1975 - Jun. 1977

E. A. Powell, M. S. Padmanabhan, and B. T. Zinn Jul. 1977 209 p refs

(Contract F04611-75-C-0036)

(AD-A044298; AFRPL-TR-77-48) Avail: NTIS HC A10/MF A01 CSCL 21/8

An approximate theory based on the Galerkin method was developed to describe the nonlinear behavior of axial-mode combustion instability in solid-propellant rocket motors and T-burners. For motors with linear combustion driving and linear particle damping (gasdynamic nonlinearities only), growth rates, limiting amplitudes and waveforms were in reasonable agreement with available 'exact' numerical solutions and experimental data. For T-burners the predicted limiting amplitudes were considerably higher than the experimentally measured values. To assess the importance of combustion nonlinearities, a heuristic nonlinear combustion response model was introduced into the approximate analysis. Results obtained with both the approximate model and the 'exact' analysis showed that nonlinear combustion effects may be important for moderate amplitudes and may account for pulsed instabilities in some cases. The higher Reynolds number correction to the Stokes Drag Law was also included in both the approximate and 'exact' analyses. Results show that nonlinear particle effects become increasingly important as particle size and/or frequency increases. Also, particle nonlinearities may have a significant effect on optimum particle size for maximum damping and may account for pulsed instabilities in some cases. Author (GRA)

N78-12143# Air Force Weapons Lab., Kirtland AFB, N. Mex.

TITAN 3 SOLID ROCKET MOTOR IMPACT STRUCTURAL RESPONSE. PHASE 1: BARE PROPELLANT IMPACT TESTS Final Report

Michael L. Crawford Aug. 1977 28 p refs

(AD-A044299; AFWL-TR-77-87) Avail: NTIS HC A03/MF A01 CSCL 21/8

The results of a series of bare solid rocket propellant (UTP-3001) impact tests are presented. The ignition sensitivity of UTP-3001 to impact is presented; however, correlation to an impact ignition model is deemed infeasible at this point. The ability of the axisymmetric finite element computer code HONDO to predict stresses and deformations accurately is shown, and a comparison with two analytic calculations is made. These tests comprise the first phase of the Titan III Solid Rocket Motor Impact Structural Response Program at the Air Force Weapons Laboratory. The purpose of the program is to define the breakup and dispersion of solid propellant in the unlikely event of a launch abort involving a launch vehicle fueled with this material. Author (GRA)

23 CHEMISTRY AND MATERIALS (GENERAL)

Includes biochemistry and organic chemistry.

No abstracts in this category.

24 COMPOSITE MATERIALS

Includes laminates.

N78-12144*# United Technologies Research Center, East Hartford, Conn.

RESEARCH ON GRAPHITE REINFORCED GLASS MATRIX COMPOSITES Annual Report

J. F. Bacon and K. M. Prewo Jun. 1977 117 p refs

(Contract NAS1-14346)

(NASA-CR-145245; R77-912545-15) Avail: NTIS HC A06/MF A01 CSCL 11D

The results of research for the origination of graphite-fiber reinforced glass matrix composites are presented. The method selected to form the composites consisted of pulling the graphite fiber through a slurry containing powdered glass, winding up the graphite fiber and the glass it picks up on a drum, drying, cutting into segments, loading the tape segment into a graphite die, and hot pressing. During the course of the work, composites were made with a variety of graphite fibers in a glass matrix. Author

N78-12145# Michigan Univ., Ann Arbor. Dept. of Mechanical Engineering.

EFFECTS OF MOISTURE AND TEMPERATURE ON THE TENSILE STRENGTH OF COMPOSITE MATERIALS Annual Report, Mar. 1976 - Mar. 1977

George S. Springer and Chi-Hung Shen May 1977 45 p refs

(Contract F33615-75-C-5165)

(AD-A044038; AFML-TR-77-82) Avail: NTIS HC A03/MF A01 CSCL 11/4

The ultimate tensile strengths of Thornel 300/Fiberite 1034 graphite epoxy composites were measured with material temperatures ranging from 200 K to 422 K and moisture contents from 0% (dry) to 1.5% (Fully saturated). All measurements were performed using 0 deg, 90 deg and pi/4 laminates. A survey was also made of the existing data showing the effects of temperature and moisture content on the tensile strength of different composites. Author (GRA)

N78-12146# Army Materials and Mechanics Research Center, Watertown, Mass. Ceramics Research Div.

THE ALPHA/BETA SILICON NITRIDE PHASE TRANSFORMATION Final Report

Donald R. Messier May 1977 30 p refs

(AD-A044520; AMMRC-TR-77-15) Avail: NTIS HC A03/MF A01 CSCL 11/2

The literature on the relevance of the alpha/beta silicon nitride transformation to hot pressing of silicon nitride ceramics is briefly reviewed as are crystal structure data for the two phases. Also mentioned are published results on the kinetics of the alpha/beta phase transformation. The kinetics of the transformation were determined by quantitative X-ray analysis on low and high purity silicon nitride powders at 1600 C. The addition of magnesia enhanced the transformation rate while the addition of yttria did not. It is concluded that the transformation proceeds via a solution-precipitation mechanism and that alpha and beta silicon nitride are respectively low and high temperature forms. Author (GRA)

N78-12147# IRT Corp., San Diego, Calif.

RADIATION EFFECTS IN INSULATOR MATERIALS Final Report, 28 Apr. 1976 - 31 Mar. 1977

J. Wilkenfeld 11 Feb. 1977 141 p refs

(Contract DAAG39-76-C-0089)

(AD-A044535; INTEL-RT-8148-011; HDL-CR-77-089-1) Avail:

NTIS HC A07/MF A01 CSCL 09/1

The thermal- and radiation-induced charges released to an external circuit have been examined for a set of polyethylene capacitors made from materials of differing crystallinities and molecular structures. Persistent internal fields were created by burn-in. It was found that the net thermal or radiation response of samples subject to burn-in is significantly enhanced if compared to those that were annealed. There was no significant dependence of sample response on fractional crystallinity for capacitors polarized under burn-in. The radiation and thermal response of a set of semirigid Teflon TFE dielectric cables has been evaluated. This has been done to (1) relate their behavior, especially the first pulse response, to the conditions of irradiation, and (2) to see if there is a correlation between the net charge released to an external circuit by radiation and by heating similar to that found for Teflon capacitors. The results of the thermally stimulated current measurements imply that the stored charge released from these cables is trapped near their surface rather than constituting a uniform volume polarization. GRA

25 INORGANIC AND PHYSICAL CHEMISTRY

Includes chemical analysis, e.g., chromatography; combustion theory; electrochemistry; and photochemistry.

For related information see also *77 Thermodynamics and Statistical Physics*.

N78-12148 Kansas Univ., Lawrence.
HIGH TEMPERATURE THERMODYNAMICS AND VAPORIZATION OF STOICHIOMETRIC TITANIUM MONOXIDE Ph.D. Thesis
Robert Isaly Sheldon 1976 206 p
Avail: Univ. Microfilms Order No. 77-16299

Constant temperature experiments (1806K) measured the equilibrium vapor pressures of Ti(g) and TiO(g). In one experiment titanium monoxide was vaporized from a tungsten Knudsen effusion cell; the vapor was collected on a water cooled quartz cap surrounding the cell. The total amount of titanium deposited on the cap was analyzed calorimetrically. In the second constant temperature experiment (1806K) the vapor composition in equilibrium with nearly stoichiometric titanium monoxide was measured mass spectrometrically. In the third experiment the temperature dependence of the ions Ti+(48) and TiO+(64) was measured mass spectrometrically. Vapor pressures were calculated as well as standard free energy, enthalpy, and entropy changes for the phase transformation. The present results are in good agreement with the thermodynamic properties reported in recently issued pages of the JANAF Thermochemical tables.
Dissert. Abstr.

N78-12149 Purdue Univ., Lafayette, Ind.
EVALUATION OF VIDICON DETECTORS FOR FLAME-EMISSION AND DERIVATIVE SPECTROSCOPY Ph.D. Thesis
Thomas Edward Cook 1976 140 p
Avail: Univ. Microfilms Order No. 77-15393

The concept and characteristics of a vidicon based spectrometer are described and illustrated by its application to the simultaneous determination of sodium and potassium in serum by flame photometry. The design and evaluation of a vidicon based rapid scanning derivative spectrometer are then described. By incorporating wavelength modulation into the electron beam interrogation pattern of the vidicon, the derivative signal is generated and detected simultaneously with the intensity spectrum. Thus in addition to scanning a spectral window, the vidicon also performs some signal processing. The potential application of the vidicon based rapid scanning spectrometer to the direct spectrophotometric determination of bilirubin in serum is described. Measurements in model chemical systems indicate that the derivative technique suffers from significantly less systematic error than corresponding multi-wavelength absorbance techniques. Dissert. Abstr.

N78-12150 Florida Univ., Gainesville.
APPLICATION OF THE LOGNORMAL DISTRIBUTION TO OPTICAL SPECTROSCOPY AND STUDIES OF ERRORS Ph.D. Thesis
Che Ted Chen 1976 143 p
Avail: Univ. Microfilms Order No. 77-17007

The lognormal distribution is a statistic for positive variables. It is applied to the positive physical quantities, such as transmitted irradiance, frequency, wavelength, etc. It is shown that the transmitted irradiance to be determined is not identical to the quantity that is measured. The way to cover the error is discussed. The lognormal distribution explains the red-shift, asymmetry and broadening of a spectral profile. It also explains why the reaction rate constant is not a constant and interprets the bending of the analytical growth curve. Dissert. Abstr.

N78-12151 Florida Univ., Gainesville.
MULTIELEMENT ATOMIC FLUORESCENCE FLAME SPECTROMETRY: EVALUATION OF A PULSED EIMAC CONTINUUM SOURCE AND CHARACTERIZATION OF BACKGROUND MOLECULAR FLUORESCENCE Ph.D. Thesis
William Kelly Fowler 1976 93 p
Avail: Univ. Microfilms Order No. 77-17014

An Eimac xenon arc continuum source operated in the pulsed mode was evaluated for potential use as a source of excitation in atomic fluorescence spectrometry. Limits of detection, precision data, and analytical curves were determined for several elements in the argon separated air-acetylene flame, and the limits of detection are compared to those obtained with a similar lamp operated in the cw mode. The lamp was found to be relatively unstable in the pulsed mode, requiring the use of a rather large residual dc current in conjunction with a relatively low-amplitude power pulse in order to sustain the arc. Moreover, the pulsed source yielded a large background signal due to scattering of incident source radiation in the flame, and the background fluorescence spectrum contained numerous large peaks due to fluorescence of molecular species in the flame and/or to prominent peaks in the spectral distribution of the pulsed lamp output, transferred to the signal detector via scatter. Dissert. Abstr.

N78-12152 Purdue Univ., Lafayette, Ind.
X-RAY PHOTOELECTRON SPECTROSCOPIC STUDIES OF ELECTRODE SURFACE STATES Ph.D. Thesis
John Sherman Hammond 1976 148 p
Avail: Univ. Microfilms Order No. 77-15412

X-ray photoelectron spectroscopy (XPS or ESCA) was used to investigate the anodic oxidation of Pt electrodes in acidic media. The identity of the intermediate oxide I species was confirmed as an oxide based on a comparison of the ESCA average calculated thickness values with the electrochemical coulometric measurements of oxide growth. Under severe anodic potentiostatic or galvanostatic conditions in low concentrations of H2SO4 or HClO4, an unlimiting growth of PtO2-xH2O was observed. Oxidation under identical conditions in high concentrations of H2SO4 or HClO4 produced a limiting growth oxide of PtOX [acid anion]4 composition. The incorporation of the acid anion in the oxide layer as a function of acid concentration therefore governs the growth of the different oxide phases. The underpotential deposition of Ag and Cu on Pt substrate electrodes was also studied by ESCA. Dissert. Abstr.

N78-12153 Purdue Univ., Lafayette, Ind.
POLAROGRAPHIC AND ULTRAVIOLET SPECTROSCOPIC INVESTIGATION OF BENZYLPENICILLENIC ACID AND OTHER DEGRADATION PRODUCTS OF BENZYLPENICILLIN Ph.D. Thesis
Mohammed Jemal 1976 259 p
Avail: Univ. Microfilms Order No. 77-15420

The direct current (dc) and differential pulse (DP) polarographic behavior of benzylpenicillenic acid and penicillamine are described and a DP polarographic method is presented for the analysis of benzylpenicillenic acid and penicillamine in potassium penicillin G for injection U.S.P. the analysis is based on the presence of sulfhydryl groups. Also, the temporal changes in the polarographic current and the UV absorbance of benzylpenicillenic acid, were compared. It was discovered by a combination of polarography and thin layer chromatography that benzylpenicillenic acid at neutral pH degrades not only to benzylpenicilloic acid but also

to penicillamine. A scheme for the formation of penicillamine was proposed. It was also concluded that in the low and high pH regions there was a transformation of the thiazolidinyl-oxazolone isomer of benzylpenicillenic acid into the UV absorbing isomer, but that in the intermediate pH region there was no such transformation. Dissert. Abstr.

N78-12154 Purdue Univ., Lafayette, Ind.
RAPID DETERMINATION OF CATECHOLAMINES AND RELATED PHENOLIC COMPOUNDS IN BIOLOGICAL MEDIA Ph.D. Thesis
Ralph Meridith Reggin 1976 174 p
Avail: Univ. Microfilms Order No. 77-15459

Liquid chromatographic methodology has been developed for the determination of catecholamines and related phenolic compounds in a variety of biological fluids and tissues. The assay methods utilize a new technique combining liquid chromatography with electrochemical detection. The possibility of deriving medically useful conclusions from urinary catecholamine data was investigated. The possible role of catecholamines in muscular dystrophy was investigated using animal models. Large increases in urinary epinephrine and norepinephrine levels were found in the dystrophic animals. The elevated catecholamines appear to be a result of oversecretion by the adrenal medulla. Tetrahydroisoquinoline alkaloids are derived from catecholamines by condensation with aldehydes. The formation of these compounds in vivo is postulated to occur under a variety of circumstances and may play a role in alcohol addiction. Methods suitable for the determination of these compounds in biological media were developed.
Dissert. Abstr.

N78-12155 Maryland Univ., College Park.
A CONTINUUM SOURCE METHOD OF ATOMIC ABSORPTION SPECTROMETRY AND ITS USE FOR CORRECTION OF SPECTRAL INTERFERENCES Ph.D. Thesis
Andrew Thomas Zander 1976 204 p
Avail: Univ. Microfilms Order No. 77-16376

A continuum source atomic absorption spectrometer (AAC) was assembled using a commercially available echelle monochromator which was modified for wavelength modulation with a refractor plate. Using slit widths typical for medium resolution conventional AAS, the very narrow spectral bandwidth of an echelle spectrometer allows the effective source width in AAC to be comparable to the absorption profile width. This results in good sensitivities, linear analytical calibration curves, and a wide dynamic range. The effect of high resolution on reducing background and the increased light throughput of newer echelles affords high signal-to-noise ratios and good detection limits. Light scattering and broadband absorption interferences are automatically and continuously discriminated against by the CEWMAA system. Dissert. Abstr.

N78-12156 Georgetown Univ., Washington, D.C.
A UNIFIED APPROACH TO ION TRANSPORT THROUGH MEMBRANES Ph.D. Thesis
Kathleen Mary Abbey 1977 221 p
Avail: Univ. Microfilms Order No. 77-17768

A model for ion transport through bilayer membranes which combines features of both the continuum and single jump approaches into a single unified model is described here. The membrane is represented by a continuous bulk phase bounded by interfacial regions where transfer from the solution to the membrane occurs. Ion transport in the continuous phase is formulated in terms of the constant field approximation, and interfacial transfer in the formalism of Erdey-Gruz and Volmer. Expressions characterizing two pathways for ion transport, viz., transport of a membrane-soluble ion and of an ion by a neutral carrier, are derived. The ability of valinomycin, an ion carrier, to affect the intrinsic membrane properties was investigated. The transport of tetraphenylborate was altered by the addition of small amounts of valinomycin to the external lithium chloride solution surrounding the membrane. Dissert. Abstr.

N78-12157 California Univ., Berkeley.
A MODEL STUDY IN CHEMISORPTION: ATOMIC HYDROGEN ON BERYLLIUM CLUSTERS Ph.D. Thesis
Charles William Bauschlicher, Jr. 1976 127 p
Avail: Univ. Microfilms Order No. 77-15603

The interaction between atomic hydrogen and the surface of Be metal was studied by electronic structure theory. Self-consistent-field (SCF) calculations were performed using minimum, optimized minimum, double zeta and mixed basis sets for clusters as large as 22 Be atoms. The binding energy and equilibrium geometry were determined for 4 sites. The minimum basis sets gave results that differed from the double zeta predictions by about 20 percent. Both spatially restricted and unrestricted SCF calculations were performed; different results were obtained in several cases. The cause of this symmetry breaking was studied for Be3H. A detailed discussion of the bonding and electronic structure is included. The remaining edge effects for the Be(22) cluster are discussed. Dissert. Abstr.

N78-12158 Arizona State Univ., Tempe.
A THEORETICAL STUDY OF HYSTERESIS IN PHASE TRANSITIONS Ph.D. Thesis
Donald Ray Knittel 1977 114 p
Avail: Univ. Microfilms Order No. 77-17391

Two theoretical models of hysteresis in phase reactions are explored. The first model is a thermodynamic model based on regular solution theory. The effects of enthalpy and entropy change, pressure, temperature and interaction energy on the hysteresis curves are examined. The influence on the hysteresis loop of temperature and composition variations of the interaction term is also studied. The theoretical results are used to fit experimentally obtained curves. A method is also discussed for obtaining the irreversible entropy and calculations are made for this entropy contribution in both the TbO sub x and PrO sub x systems. In model 2 the two phase region is considered to consist of microdomains of one phase in another. This theoretical model for phase transitions was developed from the heterophasic fluctuation theory with both a surface free energy term and a two particle interaction term which encompasses interactions between domains. Dissert. Abstr.

N78-12159 Rutgers Univ., New Brunswick, N. J.
THE DEVELOPMENT OF A TECHNOLOGY FOR PRODUCING IONICALLY CONDUCTIVE MEMBRANES OF COMPLEX SHAPE Ph.D. Thesis
Joseph Anthony Male 1977 179 p
Avail: Univ. Microfilms Order No. 77-17550

Sodium aluminate materials especially beta-alumina, show promise as solid electrolytes in high temperature battery systems. A casting technique for these materials was developed and the determination of orientation effects were carried out by X-ray diffraction and ionic conductivity measurements. As anticipated an unfavorable orientation of the plately beta''-alumina particles initially resulted from the casting operation. Control of the reaction kinetics of the starting powders was then investigated as a means to obtain a randomly oriented structure. Proper regulation of the prereaction step was found to eliminate the adverse orientation effects, reduce sintering temperature, and to produce material with an overall desirable microstructure. Dissert. Abstr.

N78-12160 New Mexico Univ., Albuquerque.
INVESTIGATION OF SULFUR BASED THERMOCHEMICAL CYCLES FOR HYDROGEN PRODUCTION BY WATER DECOMPOSITION Ph.D. Thesis
Mani Natarajan 1976 177 p
Avail: Univ. Microfilms Order No. 77-16110

A high temperature nuclear reactor was assumed to provide the primary energy for sulfur based thermochemical cycles. Flow schemes and mass balances were made for each process and cost evaluation was made by two methods. The chemistry of the reactions in each cycle was examined. An assessment of the engineering problems in the cycles was made and solutions for these problems were proposed. It was concluded that hydrogen could be produced at $10.83/MBTU (average for the three processes) in a plant having a capacity of 1,000,000 standard cubic meters per hour of hydrogen. The electrolytic hydrogen production cost for the same sized plant was found to be $10.32/MBTU. The plant investment cost estimates showed that the capital investment for the three thermochemical plants was in the range $207-270 million. Further analysis showed that an advanced electrolytic hydrogen system might produce hydrogen at $7.91/MBTU and this compares favorably with the best thermochemical system at the present time. Dissert. Abstr.

N78-12161 California Univ., Berkeley.
STUDIES IN THE SEPARATION OF NITROGEN AND OXYGEN ISOTOPES Ph.D. Thesis
Michael Lewis Nichols 1976 98 p
Avail: Univ. Microfilms Order No. 77-15801

A process for enriching 15N and 18O was studied, utilizing the adsorption of nitric oxide (NO) on 4A-30 molecular sieve. The project consisted of the following: (1) determination of the stability of NO on the molecular sieve; (2) measurement of the adsorption isotherms; and (3) measurement of the isotopic distribution between the gas and adsorbed phases. Considerable effort was directed to the interpretation of the data in an effort to gain insight into gas adsorption in molecular sieves. Isotopic separation factors for 15N, Alpha 14-15, and 18O, Alpha 16-18, were experimentally determined over the range from 120 to 193 K. The separation factor was defined as (for 15N) the molar concentration ratio of 14N16O to 15N16O in the gas phase divided by the same concentration ratio in the absorbed phase. The separation factor for 15N, Alpha 14-15, was indepedent of pressure and isotopic composition, and decreased nearly linearly with increasing temperature. The value of Alpha 14-15 at 121 K was 1.019 compared to 1.027 for nitric oxide distillation. A process evaluation, using Alpha 14-15 = 1.019 and alpha 16-18 = 1.048 at 121 K, concluded the distillation process to be superior to the proposed adsorption process.
Dissert. Abstr.

N78-12162 California Inst. of Tech., Pasadena.
THE THERMAL CONSTITUTIVE BEHAVIOR OF SUSPENSIONS Ph.D. Thesis
Thomas Joe McMillen 1977 296 p
Avail: Univ. Microfilms Order No. 77-17265

The bulk thermal constitutive behavior of flowing, neutrally buoyant suspensions is considered theoretically and experimentally. A general theoretical expression relating the macroscopic heat flux in the suspension to micro-scale velocity and temperature distributions on the length scale of the particles is derived from statistical considerations of the microstructural configuration of the suspension. Evaluation of the relation for specific conditions is discussed with particular attention given to the role of random Brownian motions of the particles. Constraints imposed by simple shear flow are considered, and it is seen that the flowing suspension may not be described by a complete effective conductivity tensor. Dissert. Abstr.

N78-12163 California Univ., Berkeley.
THE THERMOCHEMICAL DISSOCIATION OF WATER Ph.D. Thesis
John William Flock 1976 114 p
Avail: Univ. Microfilms Order No. 77-15684

Thermodynamic analyses were performed on thermochemical cycles which convert heat to chemical work by dissociating water. These analyses include: (1) the development of the relationship between the ideal work (or heat) requirements, the entropy production (a measure of the irreversibilities), and the actual work requirements of the cycle; (2) the identification of the sources of irreversibilities in chemical processes and the magnitude of the resulting entropy production in the individual operations of a proposed process utilizing chromium and chlorine to dissociate water; and (3) the effect of process changes on the entropy production in these operations. It was found that heat transfer is the major contributor to the irreversibilities in the cycle, and the utilization of waste heat increases the relative efficiency of the cycle, and that the variation of reaction temperature is significant in decreasing the entropy production in the separation operations. Other topics discussed include the availability of chemical elements for use in large scale applications and the use of solvent promotion to increase the efficiency of a water dissociation process based on reactions of molybdenum oxides.
Dissert. Abstr.

N78-12164 Princeton Univ., N. J.
ELECTROCHEMICAL CHARACTERIZATION OF HETEROGENEOUS OPTICALLY SELECTIVE CATALYSTS Ph.D. Thesis
Miriam John Fish 1977 127 p
Avail: Univ. Microfilms Order No. 77-16889

Experimental results which are used to explain the quantitative aspects of enantioselective hydrogenerations. First, an electrochemical oxidation procedure known as the potential sweep technique has been applied to the measurement of modifier coverage on nickel. The results of coverage measurements of two known modifiers, D-(+)-tartaric acid and L-(+)-glutamic acid, are given. A simple kinetic selectivity model is then presented, relating the degree of enantioselectivity to modifier coverage, which is, in turn, dependent on the adsorption conditions of the modification step. The results of the coverage measurement of tartaric and glutamic acid are related through the model to previous reports on the variation of enantioselectivity with pH and temperature of modification. The selectivity model reasonably rationalizes the major reported features: maximum in optical yields vs. pH of modification for tartaric and glutamic acid, and the decline of enantioselectivity with increasing temperature of glutamic acid modification. Dissert. Abstr.

N78-12165 Pennsylvania State Univ., University Park.
LAMINAR FREE-CONVECTIVE COMBUSTION OF A LIQUID METAL FROM A WICK Ph.D. Thesis
Theodore Robert Blakeslee, III 1977 150 p
Avail: Univ. Microfilms Order No. 77-17673

An experimental and analytical study of laminar, free-convective combustion of a liquid metal from a wick was performed, using lithium and sulfur hexafluoride as the reactant combination. Observations of the combustion process indicate a vapor-phase reaction with products condensing on the fuel surface and in the vapor phase, but not in the flame. Two theoretical models using a film-theory approximation were developed. The effect of natural convection shown by the variation of burning rate with wick length is well described by the approach developed by Spalding. The no-condensation model, which neglects condensation, predicts a weaker dependence of burning rate on pressure than exhibited by the data; however, the effect of the inert diluent in the ambient gas is predicted quite well, indicating an effect on the condensation process by the presence of the noncondensable gas. Dissert. Abstr.

N78-12166 Applied Physics Lab., Johns Hopkins Univ., Laurel, Md. Chemical Propulsion Information Agency.
ANALYTICAL MODELING OF SUDDEN EXPANSION BURNERS
R. B. Edelman Jun. 1977 36 p refs
(Contract N00017-72-C-4401)
(AD-A041961/4; CPIA-Publ-287) Avail: Issuing Activity CSCL 21/2

The mathematical models depicting the physical processes that occur in a sudden expansion (dump) burner are reviewed and assessed. These physical processes included turbulent flows, recirculating flows with swirl, finite-rate chemical kinetics, and droplet evaporation and combustion. Author

N78-12167*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EFFECT OF TRICHLOROFLUOROMETHANE AND MOLECULAR CHLORINE ON OZONE FORMATION BY SIMULATED SOLAR RADIATION
David A. Bittker and Edgar L. Wong Nov. 1977 22 p refs
(NASA-TP-1093; E-9078) Avail: NTIS HC A02/MF A01 CSCL 04A

Mixtures of air with either Cl2 or CFCl3 were photolyzed in a reaction chamber by simulated solar radiation. Ozone formation was temporarily inhibited by Cl2 and permanently inhibited by CFCl3. A chemical mechanism including gas phase and wall reactions is proposed to explain these results. The CFCl3 is assumed to be adsorbed on the chamber walls and to poison the sites for Cl destruction. Author

N78-12168*# Lehigh Univ., Bethlehem, Pa. Sinclair Lab.
ANALYSIS OF RESULTS OF ASTP EXPERIMENT IN ELECTROPHORESIS Final Report
J. W. Vanderhoff, F. J. Micale, and P. H. Krumrine Jul. 1977 43 p refs
(Contract NAS8-32124)
(NASA-CR-150469) Avail: NTIS HC A03/MF A01 CSCL 07D

The Apollo-Soyuz Test Project (ASTP) included an electrophoretic separation experiment of biological cells. The nature separation

results of aldehyde-fixed rabbit, human and horse red blood cells, which were taken in the form of photographs taken at three-minute intervals, are the subject of this report. The electrophoretic separation was successful in that fractionation according to mobility did occur and was found in the sliced samples. Photographic evidence indicates that the low electroosmotic methylcellulose coating was successful in reducing the electroosmosis to a near zero value. Also, the flight film shows that the bands migrated down the column as theory would predict, producing two bands of high cell concentration separated and surrounded by regions of lower cell concentration. However, most likely some clumping of cells occurred to cause the trailing band to be larger than expected from theory. Overall, the experiment was a success in demonstrating a static electrophoresis separation under microgravity conditions with a resolution not possible on earth. Author

N78-12169*# Nevada Univ., Reno. Atmospheric Sciences Center.
ANALYSIS OF THE DEPLETION OF A STORED AEROSOL IN LOW GRAVITY Final Report, 5 Jan. 1976 - 30 Jun. 1977
Patrick Squires 23 Nov. 1977 34 p refs
(Contract NAS8-31780)
(NASA-CR-150476) Avail: NTIS HC A03/MF A01 CSCL 07D

The depletion of an aerosol stored in a container has been studied in l-g and in low gravity. Models were developed for sedimentation, coagulation and diffusional losses to the walls. The overall depletion caused by these three mechanisms is predicted to be of order 5 to 8 percent per hour in terrestrial conditions, which agrees with laboratory experience. Applying the models to a low gravity situation indicates that there only coagulation will be significant. (Gravity influences diffusional losses because of convection currents caused by random temperature gradients). For the types of aerosol studied, the rate of depletion of particles should be somewhat less than 0.001 N percent per hour, where N is the concentration per cu cm. Author

N78-12170# ARO, Inc., Arnold Air Force Station, Tenn.
ISOLATED CO LINES FOR USE IN COMBUSTION GAS DIAGNOSTICS Final Report, 1 Jul. 1975 - 30 Jun. 1976
B. Krakow, E. L. Kiech, and H. A. McAdoo AEDC Sep. 1977 28 p refs
(AD-A044053; ARO-ETF-TR-76-86; AEDC-TR-77-11) Avail: NTIS HC A03/MF A01 CSCL 21/2

High resolution (approx. 0.1/cm) measurements of both emission and absorption spectra in the fundamental band of CO (from 2000 to 2200/cm) have been made of a variety of samples representing a wide range of temperatures and pressures using a Fourier transform spectrometer. Examination of these spectra have indicated the presence of a number of isolated CO lines that appear potentially useful for determination of CO concentration and temperature in combustion gas flows. The spectra are analyzed and the isolated lines identified. Author (GRA)

N78-12171# Life Systems, Inc., Cleveland, Ohio.
FUNDAMENTAL STUDIES FOR DEVELOPMENT OF ELECTROCHEMICAL COD AND TOC ANALYZERS Annual Report, 1 Sep. 1976 - 31 Aug. 1977
R. J. Davenport and R. A. Wynveen Sep. 1977 76 p refs
(Contract DAMD17-76-C-6077)
(AD-A044026; LSI-ER-310-4) Avail: NTIS HC A05/MF A01 CSCL 07/4

The essential components of the Electrochemical COD and TOC Analyzers have been assembled, tested and evaluated. In situ electrochemical generation of persulfate has been demonstrated. Sensors to monitor persulfate and carbon dioxide in the analyzers have been developed and tested. The sensors have demonstrated the ability to measure chemical oxygen demand (COD) and total organic carbon (TOC) concentrations. Therefore, compact, portable, simple and relatively low cost analyzers may be developed using these components for use in field applications. An advantage is that in situ generation of persulfate in the analyzers will allow them to operate without consumables. Also, a single analyzer that can measure both COD and TOC concentrations is a demonstrated possibility. Results, conclusions and recommendations are presented. Author (GRA)

N78-12172# Washington Univ., Seattle. Dept. of Chemistry.
PROBLEMS OF DIFFUSION IN A LOW PRESSURE GAS STREAM AS RELATED TO THE POLANYI DIFFUSION FLAME (CLOUD) METHOD
D. G. Keil, J. F. Burkhalter, and B. S. Rabinovitch 1 Sep. 1977 35 p refs
(Contract N00014-75-C-0690)
(AD-A044436; NR092-549-TR06) Avail: NTIS HC A03/MF A01 CSCL 07/4

In anticipation of the application of the Polanyi diffusion flame (cloud) technique to the study of unimolecular reactions and energy transfer at higher temperatures, we have investigated some experimental and theoretical aspects of the time-dependent and steady-state behavior of diffusion of a reactant into a low pressure (approximately equal to torr) gas stream. A study of the diffusion of Hg vapor in N2 atmospheric gas was made. The effects of the Hg inlet nozzle configuration and the inlet gas flow rate on the diffusion process and on the atmospheric gas stream have been investigated. Monte Carlo calculations have been made to reveal the time-dependent and steady-state behavior of a species diffusing from a point source into gas stream having various velocity profiles. Some aspects of a reactive diffusing specie are also treated mathematically. The present results are integrated with previous results of other investigators in order to provide an overall view of the relationship between real and model flow systems. Author (GRA)

N78-12173# California Univ., Santa Barbara. Quantum Inst.
CHEMICAL GENERATION OF GASEOUS EXCITED OXYGEN Final Report
Paul H. Lee and Warren D. Slafer Aug. 1977 152 p refs
(Contract F29601-75-C-0058)
(AD-A044024; AFWL-TR-76-90) Avail: NTIS HC A08/MF A01 CSCL 07/1

The object of the work was to design, build, and test a chemical generator to produce a high yield of electronically excited oxygen molecules, O2. The generator is needed as a laboratory tool and as a model for scaling future apparatus to produce larger outputs. The work is divided into three parts. In Part One, the candidate chemical reaction was chosen, the chemical generator and necessary output measuring devices were designed and built, and preliminary data were obtained. The second part was a study of the effects of systematic changes in operating parameters on the performance of the generator. The third part was a consolidation of the results obtained from Part Two into modifications and improvements of the generator with the objective of maximizing the O2 yield. GRA

N78-12174# California Univ., San Diego. Dept. of Chemistry.
SYNTHESIS AND APPLICATION OF NEW COORDINATION COMPOUNDS WITH SULFUR DONOR LIGANDS Final Technical Report
G. N. Schrauzer 25 Jan. 1977 6 p refs
(Contract N00014-75-C-0304; NR Proj. 053-529)
(AD-A044510; UCSD-8236) Avail: NTIS HC A05/MF A01 CSCL 07/2

The projects studied involved the development of a new method of preparation of superconducting phases in Nb-Ge, Nb-Sn, V-Si, V-Ge, V-Sn, Nb-C and Mo-C systems, the preparation of conducting complexes of multidentate organic sulfur ligands and the discovery of a superconducting phase in the Li-Ti-O systems. Author (GRA)

N78-12175# Massachusetts Inst. of Tech., Cambridge. Dept. of Chemistry.
PHOTOCATALYZED REACTIONS OF ALKENES WITH SILANES USING TRINUCLEAR METAL CARBONYL CATALYST PRECURSORS
Richard G. Austin, Ralph S. Paonessa, Paul J. Giordano, and Mark S. Wrighton 14 Sep. 1977 47 p refs
(AD-A044506; TR-9-ONR) Avail: NTIS HC A03/MF A01 CSCL 07/3

Irradiation of M3(CO)12 (M = Fe, Ru, Os) in the presence of 1-pentene and HSIET3 yields (n-penty 1)SIET3, three isomers of (penteny1)SIET3, and N-pentane, For M = Fe, Ru the catalytically active species are mononuclear, but for M = Os the trinuclear unit may remain in the active species. Observed

quantum yields for reaction exceed ten for near-UV excitation.
Author

N78-12176# Wisconsin Univ., Madison. Dept. of Chemistry.
A NEW EMPIRICAL POTENTIAL HYPERSURFACE FOR BIMOLECULAR REACTION SYSTEMS Interim Report
Oded Kafri and Michael J. Berry 1977 13 p refs
(Grant AF-AFOSR-2423-73)
(AD-A044719; AFOSR-77-1170TR) Avail: NTIS HC A02/MF A01 CSCL 07/4

A fully empirical procedure for generating chemically accurate potential hypersurfaces for triatomic bimolecular reaction systems is described and applied to the H3 system. Author (GRA)

N78-12177# Pennsylvania State Univ., University Park. Dept. of Mechanical Engineering.
ANALYSIS AND THEORETICAL MODELING OF THE COMBUSTION OF GRANULAR PROPELLANTS, WITH EXPERIMENTAL VERIFICATIONS Final Report, 15 Feb. 1974 - 14 Feb. 1977
K. K. Kuo Jun. 1977 11 p refs
(Grant DAAG29-74-G-0116)
(AD-A043337; ARO-11731.4-E) Avail: NTIS HC A02/MF A01 CSCL 19/1

Gas-permeable propellants possess great potential for producing sizable thrusts within extremely short time intervals. A research program was set up with the objectives: (1) to obtain a deeper understanding of high speed flame propagation and the gas dynamic behavior of two-phase reactive flow systems; and (2) to predict the rates of gasification during transient heterogeneous combustion of granular propellant beds. GRA

N78-12178# Ballistic Research Labs., Aberdeen Proving Ground, Md.
RELATIVE TRANSITION PROBABILITIES IN THE A-X SYSTEM OF OD
David R. Crosley and Russell K. Lengel Aug. 1977 47 p refs
(DA Proj. 1L1-61102-AH-43)
(AD-A044534; BRL-2008) Avail: NTIS HC A03/MF A01 CSCL 07/4

In the fashion of a previous study on the OH molecule, branching ratios for emission from the zeroth, first, and second vibrational levels of the A-doublet-sigma-plus state of OD have been measured using frequency doubled tunable dye laser excitation. The six independent ratios so obtained are used to assess calculations incorporating an electronic transition moment varying linearly with internuclear distance, a form judged superior from the OH work. Calculations of the rotational dependence of the transition probabilities in OD, and comments on some recent OH investigations are included. Author (GRA)

N78-12179# Naval Surface Weapons Center, Indian Head, Md.
NITROGEN TRIFLUORIDE: ITS CHEMISTRY TOXICITY, AND SAFE HANDLING Summary Report, Mar. 1974 - Aug. 1975
Frank J. Pisacane, Edward Baroody, Robert Robb, Ottmar Dengel, H., William Gilligan, George Wilmot, Anthony Rowek, and Barry Rallay 12 Nov. 1976 35 p refs
(AD-A044515; NSWC/WOL/MP-76-24) Avail: NTIS HC A03/MF A01 CSCL 07/2

Nitrogen trifluoride (NF3) is the most promising near-term replacement for fluorine in a DF chemical laser. Safety and compatibility characteristics of NF3 have been scattered through the literature since the gas was first prepared by Ruff in 1928. Most of the data have been obtained to outline the general chemical behavior of NF3 and leave many critical safety, compatibility and environmental questions unanswered. Moreover, some of the data found in the literature are erroneous. As part of the Advance Reactants Program at the Naval Surface Weapons Center, an experimental program was conducted to: (1) determine safety and compatibility characteristics of NF3 under various conditions with gases, liquids, and solids with which it might come into contact; (2) survey the available toxicity data; (3) develop adequate detection techniques; and (4) recommend safe handling, fire-fighting, and emergency disposal methods.
Author (GRA)

N78-12180# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE STUDY OF THE INTERACTION OF SILICON, ITS MONOXIDES, AND DIOXIDES WITH CHLORINE
P. Kuznetsov, S. Petrov, and A. I. Vakhrusheva 1 Feb. 1977 20 p refs Transl. into ENGLISH from Izv. Sibirsk. Otd. Akad. Nauk SSSR, Ser. Khim. Nauk (Novosibirsk), issue 3, no. 7, 1972 p 42-46
(AD-A044671; FTD-ID(RS)I-0076-77) Avail: NTIS HC A02/MF A01 CSCL 07/4

A thermodynamic calculation of the chlorination of silicon and its oxides is reported. On the basis of this, a conclusion was made. An hypothesis was proposed for the conditions of the interaction of silicon monoxides with chlorine. These are believed to be determined to a significant degree by the strength of bonds Si - O, the weakening of which depends on both temperature and sorption of the chlorine. The products of this interaction (SiCl4 and SiO2) were determined. GRA

N78-12181# Carnegie-Mellon Univ., Pittsburgh, Pa. Dept. of Statistics.
A NEW STOCHASTIC ANALYSIS OF CHEMICAL KINETICS Interim Report.
John P. Lehoczky Jun. 1977 34 p refs
(Grant AF-AFOSR-2642-74)
(AD-A044573; TR-129; AFOSR-77-1212TR) Avail: NTIS HC A03/MF A01 CSCL 07/4

A new approach to the formulation and analysis of stochastic models of chemical reactions is presented. Unimolecular, bimolecular, and enzyme kinetic reactions are considered in the irreversible and reversible cases. The methodology is based on diffusion approximations and represents the time evolution of the reaction as the sum of a deterministic function and an Ornstein-Uhlenbeck process. As a result the marginal distributions are approximately Gaussian with relatively simple mean and covariance parameters, and the dynamic behavior is completely characterized. The stochastic approach which uses stochastic differential equations is a natural generalization of the deterministic approach which uses ordinary differential equations.
Author (GRA)

N78-12182# Indiana Univ., Bloomington. Dept. of Chemistry.
SIMPLIFIED APPARATUS FOR ROUTINE SELECTIVE SPECTRAL-LINE MODULATION ATOMIC ABSORPTION SPECTROMETRY Interim Technical Report
R. L. Cochran and G. M. Hieftje Sep. 1977 46 p refs Submitted for publication
(Contract N00014-76-C-0838; NR Proj. 051-622)
(AD-A045218; TR-8) Avail: NTIS HC A03/MF A01 CSCL 07/4

A selective spectral-line modulation (SLM) atomic absorption instrument is described which exhibits the operational simplicity and reliability needed for routine analytical application. In this SLM design, a conventional pneumatic nebulizer/spray-chamber and slot-burner-supported flame form the modulating atom cell, and a mirrored chopper directs the continuum radiation alternately around or through this atom cell, thus performing the selective modulation function. The sensitivity and analytical curve linearity obtained for Ca and Cu with the present SLM system extend to an absorbance of about 0.3, approaching those obtainable using a line source within the same system. Detection limits found for a series of elements with the present SLM design are shown to be little improved over those for conventional, medium-resolution, continuum-source atomic absorption spectrometry. Important noise characteristics of the present SLM device are examined. Author (GRA)

26 METALLIC MATERIALS

Includes physical, chemical, and mechanical properties of metals, e.g., corrosion; and metallurgy.

N78-12183* California Univ., Berkeley.
DETERMINATION OF THE SURFACE COMPOSITION OF BINARY ALLOYS BY AUGER ELECTRON SPECTROSCOPY: THE GOLD-SILVER AND GOLD-TIN SYSTEMS

Ph.D. Thesis
Steven Henry Overbury 1976 223 p
Avail: Univ. Microfilms Order No. 77-15813

Polycrystalline Au-Ag alloy foils of a wide range of composition were cleaned and equilibrated in ultra high vacuum. Using two different types of energy analyzers for comparison, the intensities of the Auger emission from transitions at several energies were measured and normalized to those of pure Au and Ag. A model developed to describe the intensity of Auger emission was applied to the intensities and the surface monolayer compositions of the alloys were thus determined. The Auger data were consistent with enrichment of Ag in the surface monolayer. Dissert. Abstr.

N78-12184 Pennsylvania State Univ., University Park.
KINETICS OF THE INITIAL STAGE SINTERING OF ALUMINA Ph.D. Thesis
Jean-Marie Bind 1977 180 p
Avail: Univ. Microfilms Order No. 77-17672

The chemical potential gradient of the atoms at the neck surface of two particles interpenetrating each other is selected as the driving force for this sintering model. The chemical potential is a function of the geometry of the system under consideration, the local stress along the grain boundaries, and the composition of the material. The geometry of the model is refined by analytical methods and all the variable parameters are accurately related to the shrinkage. It is then possible to propose a mathematical description of the profile of the chemical potential over a grain boundary, and the extension to hot pressing is easily made by modifying the boundary conditions. Dissert. Abstr.

N78-12185 Kentucky Univ., Lexington.
DEFORMATION KINETICS OF Ti-5Al-2.5 Sn AT LOW TEMPERATURES (> 0.3 T SUB M) Ph.D. Thesis
Srinivasan Raghuraman 1976 202 p
Avail: Univ. Microfilms Order No. 77-15964

The plastic deformation of Ti-5Al-2.5Sn alloy at low temperatures was studied in three parts. In the first part, the characterization of structure of Ti-5Al-2.5Sn was made. Secondly, the effective stress responsible for dislocation motion was determined in a variety of ways from macroscopic flow stress measurements at room temperature. Finally, the effect of strain rate on the flow stress of polycrystalline Ti-5Al-2.5Sn was determined using uniaxial tension tests. Dissert. Abstr.

N78-12186 Kentucky Univ., Lexington.
ANALYSIS OF THE WARM AND HOT DEFORMATION OF 5086 ALUMINUM ALLOY THAT IS POTENTIALLY DYNAMICALLY STRAIN AGEABLE Ph.D. Thesis
Brijmohan Jaisingh Roopchand 1976 267 p
Avail: Univ. Microfilms Order No. 77-15970

A 5068 aluminum-magnesium alloy containing a small amount of manganese was selected for the investigation. It appears that the structural condition just prior to hot working is one of the important factors controlling the final structure of the hot worked material. It dictates whether the material behaves as an alloy or as a pure metal. If the solute is primarily in solid solution the material behaves as an alloy; however if the solute is primarily out of solid solution the material behaves like a pure metal. Dissert. Abstr.

N78-12187 Carnegie-Mellon Univ., Pittsburgh, Pa.
FORMABILITY OF SANDWICH SHEET MATERIALS Ph.D. Thesis
Sheldon Lee Semiatin 1977 268 p
Avail: Univ. Microfilms Order No. 77-16778

The deformation processing behavior of sandwich sheet materials was investigated for primary as well as secondary metalforming operations. Plane strain indentation and rolling experiments on sandwich sheets of stainless steel clad aluminum and aluminum clad stainless steel were used to gain insight into the compressive modes of deformation involved in primary forming. The secondary operations of drawing and stretching were simulated in punch forming experiments, and the observed phenomena correlated to uniaxial tension behavior. In addition to measurements of stress-strain curves in tension and compression, determinations of residual stress distributions in specimens deformed in tension and rolling have been used to obtain information about states of stress during forming. With this knowledge, predictions of formability are advanced, which compare favorably with experimental observations. Dissert. Abstr.

N78-12188 California Univ., Berkeley.
STRUCTURE AND MECHANICAL PROPERTIES OF Fe-Cr-Mo-C ALLOYS WITH AND WITHOUT BORON Ph.D. Thesis
Yen-Lung Chen 1976 123 p
Avail: Univ. Microfilms Order No. 77-15632

The structure and mechanical properties of Fe-Cr-Mo-C martensitic steels with and without boron addition are studied. Although boron seems to impair room temperature impact toughness at low strength levels, it does not affect this property at high strength levels. By simple non-conventional heat treatments of the present alloys, martensitic steels are produced with quite good strength-toughness properties which are much superior to those of existing commercial ultra-high strength steels. Dissert. Abstr.

N78-12189 Pennsylvania State Univ., University Park.
OXIDATION OF IRON AND SOME IRON-BASED ALLOYS IN CONTROLLED ATMOSPHERES AT ELEVATED TEMPERATURES Ph.D. Thesis
Anil Prabhakar Lingras 1977 238 p
Avail: Univ. Microfilms Order No. 77-17707

The sticky scale problem is considered that is encountered when iron-based alloys are subjected to soaking pit and reheating operations. Kinetics of oxidation of Fe, Fe-Cu and Fe-Ni alloys were studied in CO2/H2 and CO2/CO atmospheres. Oxide alloy interfaces of Fe-Cu, Fe-Ni, Fe-Si, Fe-Cr and Fe-Cr-Cu alloys oxidized in simulated soaking pit atmospheres were studied metallographically and with the help of electron probe microanalyses and X-ray imaging techniques. The linear rate constant of oxidation was found to increase with oxygen potential. A decrease in the reverse reaction at high oxygen potentials and an increase in forward reaction at low potentials was found to be responsible for this behavior. A decrease in activity of iron was found to decrease the phase boundary reaction constant. Dissert. Abstr.

N78-12190 California Univ., Berkeley.
EFFECTS OF THE TRIP PHENOMENON ON THE TOUGHNESS OF HEAT TREATABLE ALLOY STEELS Ph.D. Thesis
Gabriel Kohn 1976 136 p
Avail: Univ. Microfilms Order No. 77-15742

It is shown that substantial amounts of untransformed austenite may be obtained in low alloy steels by a combination of alloy modification (addition of silicon) and heat treatment. In silicon modified AISI 4330 steel, the amount of untransformed austenite is varied by utilizing isothermal treatments both above and below the M sub s. The stability of the untransformed austenite was found to be dependent on the amount of silicon and also on the tempering temperature. A magnetic saturation technique was utilized to monitor the transformation of the austenite under uniaxial tensile loading. An improvement in the plane strain fracture toughness was observed when the retained austenite transformed with respect to strain. This improvement was optimized with particular combinations of stability and volume fractions of retained austenite. Dissert. Abstr.

N78-12191 California Univ., Berkeley.
DUCTILE FRACTURE IN METALWORKING PROCESSES Ph.D. Thesis
Soo Ik Oh 1976 211 p
Avail: Univ. Microfilms Order No. 77-15809

Ductile fracture behavior in two aspects was studied. One is the prediction of workability of a material in metalworking processes and the other is the examination of the microscopic deformation field around voids which lead to fractures. The workability predictions are made with Al 7075-T6 by combining the fracture criteria and deformation mechanics of metal-forming processes. The studies of workability are confined to upsetting and rolling where free-surface cracks occur. A fracture criteria of free-surface cracks, which had been obtained from the experimental observations with several steels, was chosen. It is also shown that this criterion is in conformity with others which were derived theoretically as well as phenomenologically. For the deformation mechanics complete solutions of upsetting are

obtained by the matrix method which is essentially a finite-element method with rigid plastic material. Dissert. Abstr.

N78-12192 Iowa State Univ. of Science and Technology, Ames.
THE EFFECTS OF CRYOFORMING AND AGING ON THE STRUCTURE AND MECHANICAL PROPERTIES OF AN AUSTENITIC STAINLESS STEEL ALLOY Ph.D. Thesis
Justin Opoku 1977 131 p
Avail: Univ. Microfilms Order No. 77-16970

The effects of cryoforming and aging on the structure and cryogenic mechanical properties of an austenitic stainless steel were investigated. The effects of deformation temperature, prestrain level, and post deformation aging parameters were studied. Specimens were deformed in tension to three strain levels at each of two cryogenic temperatures, -196 C and -73 C, and subjected to natural and artificial aging. To evaluate the effects of the processing parameters, specimens were tested in tension at -196 C. Testing at -73 C was carried out only on samples subjected to optimum aging conditions. To provide a basis for evaluating the advantages of the thermomechanical process, specimens were deformed at room temperature and tested at the two cryogenic temperatures. The improved strength was due to strain-induced martensite, strain hardening of the freshly formed martensite and retained austenite, and iron-chromium carbides precipitated during aging. Aging the cryo-formed austenitic stainless steel between 400 C and 450 C produced optimum mechanical properties. Dissert. Abstr.

N78-12193 California Univ., Berkeley.
SINTERING OF Al2O3 POWDER COMPACT BY HOT STAGE SCANNING ELECTRON MICROSCOPY Ph.D. Thesis
David Nin-Kou Wang 1976 144 p
Avail: Univ. Microfilms Order No. 77-15902

A constant heating rate technique is used to study MgO-doped and undoped Al2O3 powder compacts with variations in green density. Hot stage scanning electron microscopy was used to monitor continuously the linear dimensional change of a powder compact throughout the densification process at various constant heating-rates. Extensive studies on the microstructural evolution correlated with the densification and grain growth kinetics. The maximum densification ate was found to occur at a critical density which was independent of the heating rate as long as the green density remained constant. Microstructural evolution has been correlated with the densification rate to explain the occurrence of the maximum rate of densification. It was found that there is no effect of MgO dopant on either process until the critical density is reached. Dissert. Abstr.

N78-12194 Drexel Univ., Philadelphia, Pa.
THE COMPRESSIBILITY OF LIQUID TIN AND INDIUM Ph.D. Thesis
Carole Angela Daniels 1977 147 p
Avail: Univ. Microfilms Order No. 77-17222

The density and thermal expansion of liquid tin and liquid indium were measured for temperatures ranging from the respective melting points, 566 K and 509 K, to 1757 K. Compressibility for both metals was also measured over the pressure range of 0 to 1000 atmospheres and for the temperatures, 566 K to 1349 K for tin and 509 K to 1757 K for indium. The density for both tin and indium was found to be a linear function of temperature over the entire temperature range investigated. Dissert. Abstr.

N78-12195 State Univ. of New York, Stony Brook.
EFFECT OF ACTIVATORS ON THE KINETICS OF PACK ALUMINIZATION ON PURE NICKEL Ph.D. Thesis
Bhupendra Kumar Gupta 1976 204 p
Avail: Univ. Microfilms Order No. 77-17212

Coating experiments were performed in AlF3, sodium and ammonium halide activated packs. The effect of amount of activator, pack Al content, and coating temperature were also studied. The theory of pack aluminization for AlF3 activated pure Al packs was extended to sodium and ammonium halide activated packs. Theoretically predicted and experimentally observed results on the aluminization of pure Ni were found to be in good agreement. Dissert. Abstr.

N78-12196 Materials Research Labs., Melbourne (Australia).
ELECTRODEPOSITION PAINTING OF METAL SUBSTRATES
J. A. Gagliardi and D. J. Whelan Jul. 1977 51 p refs
(MRL-R-693; AR-000-663) Copyright. Avail: Issuing Activity

A review of various coating techniques indicated that the process of electrodeposition should meet the requirements for a thin uniform coating on steel cylinders. Various water-borne electrodeposition paints based on acrylic resins were formulated. Properties of films deposited onto various metal substrates from these paints and from an Australian-made paint were studied in detail. Durable films with good adhesion, scratch and impact resistance were deposited on mild steel, on aluminium, and on tin-plated panels, although the surface finish on both aluminium and tin-plate is less smooth than that on steel. Author

N78-12197*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
A TECHNIQUE TO CORRECT FOR SAMPLE THICKNESS VARIATIONS FOR USE WITH IDAPS X-RAY RADIOGRAPH ANALYSIS
Charles F. Schafer and Mark Paulk Sep. 1977 20 p refs
(NASA-TM-78140) Avail: NTIS HC A02/MF A01 CSCL 11F

The Image Data Processing System (IDAPS) at the Marshall Space Flight Center is used to analyze radiographs of metal samples to qualitatively and quantitatively map compositional variations across the samples. When the X-ray radiographs are of samples having thickness variations, corrections must be made to accomplish compositional analysis. A correction technique is described for cylindrical samples and is applied to radiographs of SPAR Experiment 74-18. Uncorrected and corrected images are shown. Author

N78-12198# Army Armament Research and Development Command, Watervliet, N. Y. Benet Weapons Lab.
COMPUTERIZING THE EFFECTS OF TEMPERING ON THE MECHANICAL PROPERTIES OF A Ni-Cr-Mo STEEL
Peter Dembowski Jun. 1977 26 p refs
(AD-A044224; ARLCB-TR-77030) Avail: NTIS MF A01 CSCL 11/6

As part of an attempt to determine the optimum tempering cycle for gun tubes, mechanical properties of an AISI 4337 modified steel, i.e. gun steel, were determined for various tempering cycles. Austenitization temperatures of 845 C (1553 F) and 955 C (1750 F) were used, with tempering temperatures ranging from 425 C (797 F) to 595 C (1103 F) and tempering times ranging from 15 minutes to 240 minutes. This format, which allows the selection of tempering parameters from one plot to achieve desired properties, was developed. The mechanical property results for the material austenitized at 845 C are presented in the form of three dimensional plots and contour maps which interrelate the mechanical property of interest and tempering temperature and time. Examples showing the use of the plots are presented. Author (GRA)

N78-12199# Naval Research Lab., Washington, D. C.
SEM OBSERVATIONS OF FRACTURE SURFACES OF FATIGUE SPECIMENS OF ANNEALED TYPE 316 STAINLESS STEEL Final Report
F. A. Smidt and V. Provenzano 10 Aug. 1977 28 p refs
(AD-A044215; NRL-8133) Avail: NTIS HC A03/MF A01 CSCL 11/6

The fracture surfaces of fatigue specimens of Type 316 stainless steel previously tested at elevated temperatures in air have been examined by scanning electron microscopy (SEM) to characterize the failure processes and to establish correlations with the previous studies of fatigue crack propagation. The SEM observations show three significantly different types of behavior which can be explained in terms of the differences in materials processing history and test conditions. Solution-annealed material tested at 800 F (427 C) exhibits a transgranular failure mode with fatigue striations indicative of a ductile failure process. Solution-annealed material tested at 1100 F (593 C) shows a change in failure mode to partially intergranular failure and an increase in crack propagation rate relative to the tests at 800 F (427 C). Imposition of a hold time further increases the proportion of the surface characterized by intertranular failure, and the crack growth rate also increases. Material aged at 1100 F (593 C)

and tested at 1100 F (593 C) shows a return to the transgranular failure mode and a lower crack growth rate than solution annealed material tested at 1100 F (593 C). The imposition of a hold time period had no significant effect on the failure mode. The observations are consistent with a model in which grain boundary embrittlement caused by diffusion of oxygen ahead of the crack tip produces intergranular failure and an acceleration of crack growth rate. GRA

N78-12200# Rockwell International Corp., Thousand Oaks, Calif. Science Center.
NONDESTRUCTIVE INSPECTION OF PHOSPHORIC ACID ANODIZED ALUMINUM PANELS FOR CONTAMINATION Final Report, 15 Mar. 1975 - 15 Dec. 1976
Tennyson Smith Apr. 1977 264 p refs
(Contract F33615-75-C-5235)
(AD-A044241; SC5026.22TR; AFML-TR-77-42) Avail: NTIS HC A12/MF A01 CSCL 11/6

This report describes a study of nondestructive inspection (NDI) for contaminants on phosphoric acid anodized aluminum alloys (Al 7075-T6 and Al 2024-T3). Contamination is used in the broad sense to include surface preparation process errors (such as incorrect anodize time or voltage) and handling damage as well as organic contamination from humans and smog. Panels were deliberately contaminated to various levels and then inspected by automated scanning with three surface tools. The tools were, ellipsometry, surface potential difference (SPD), and water contact angle. Ellipsometry proved to be the most useful, detecting all types of contamination. SPD was partially successful for processing errors and organic contamination but was not successful for handling damage. Contact angle measurements were successful for nonpolar organic contamination only. The anodic films are too thick for useful photoelectron emission (PEE) but this technique is very useful for other surface treatment such as FPL etch. The best NDI instrument should include ellipsometry and SPD but ellipsometry alone will probably be adequate. SPD alone would not be adequate. Author (GRA)

N78-12201# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CASTING ALLOY ON A TITANIUM BASE
G. A. Kaplunovskiy, O. N. Magnitskiy, T. T. Nartova, B. B. Gulyayev, I. I. Kornilov, A. M. Podpalkin, V. P. Kuznetsov, and L. Ye. Solntseva 26 Jan. 1977 10 p Transl. into ENGLISH from Russian Patent no. 308082 p 1
(AD-A044676; FTD-ID(RS)I-0092-77) Avail: NTIS HC A02/MF A01 CSCL 11/6

The invention pertains to the field of nonferrous metallurgy, namely to the search for high-strength light materials for making shaped castings. The purpose of the invention is to increase the strength properties of titanium alloys while retaining the high casting properties. GRA

N78-12202# Southwest Research Inst., San Antonio, Tex.
COMPRESSIVE MICROFRACTURE AND INDENTATION DAMAGE IN Al2O3 Interim Technical Report, 1 Mar. - 30 Aug. 1977
James Lankford, Jr. 30 Aug. 1977 19 p refs
(Contract N00014-75-C-0668)
(AD-A044655; SwRI-02-4231-001) Avail: NTIS HC A02/MF A01 CSCL 11/2

Compressive damage in alumina has been characterized as a function of strain rate and temperature. Scanning electron microscopy and acoustic emission were employed in examining both the early crack initiation and later failure stages of damage caused by uniaxial compressive stress. The formation of lateral cracks produced during indentation loading is characterized in terms of microplasticity, and the particle velocity range over which the mechanism is expected to be operative is computed. Author (GRA)

N78-12203# Rensselaer Polytechnic Inst., Troy, N. Y. Dept. of Materials Engineering.
ELECTRON PROBE MICROANALYSIS OF CONCENTRATION SEGREGATION IN ALUMINUM-ZINC-MAGNESIUM Final Report
G. Judd 25 Aug. 1977 8 p
(Contract N00014-75-C-0504)
(AD-A044740) Avail: NTIS HC A02/MF A01 CSCL 11/6

A summary report is presented on the studies of microsegregation and microstructure in Al-Zn-Mg-Ti alloys performed under the contract entitled, Electron Probe Microanalysis of Concentrations Segregation in Aluminum-Zinc-Magnesium. Author (GRA)

N78-12204# Georgia Inst. of Tech., Atlanta. School of Chemical Engineering and Metallurgy.
THE CYCLIC STRESS-STRAIN RESPONSE OF TITANIUM-VANADIUM ALLOYS
S. B. Chakrabortty, T. K. Mukhopadhyay, and E. A. Starke, Jr. 30 Aug. 1977 44 p refs
(Contract N00014-75-C-0349; NR Proj. 031-750)
(AD-A044617; GIT-TR-77-1) Avail: NTIS HC A03/MF A01 CSCL 11/6

The cyclic stress-strain response of four Ti-V alloys (24, 28, 32 and 36 wt % V) which have deformation modes ranging from coarse twinning to wavy and planar slip, has been measured and correlated with deformation mode and microstructure. When coarse twinning is the primary deformation mode an anomalous Bauschinger effect, associated with untwinning during load reversal, is observed. A saturation flow stress is not obtained for the wavy slip alloy due to the intervention of microtwinning which inhibits cross slip and cell formation. Cyclic hardening of all alloys appears to be related, in some degree, to deformation twinning. Cyclic softening occurs for the planar slip alloys in the absence of microtwinning due to increasing mobile dislocation density. Author (GRA)

N78-12205# Battelle Columbus Labs., Ohio.
IMPLICATIONS OF ALLOY STRUCTURE WITH RESPECT TO MECHANICAL PROPERTIES Final Report
L. R. Kahn, A. J. Markworth, P. C. Gehlen, and G. T. Hahn 31 May 1977 77 p refs
(Contracts N00014-76-C-0181; N00014-70-C-0390)
(AD-A044614) Avail: NTIS HC A05/MF A01 CSCL 11/6

The primary objective of this project has been to relate the toughness of metals, including effects of hydrogen, to physical properties at the atomic level. The approach is based on computer-simulation techniques that describe a crack-containing crystal comprised of the order to a thousand atoms. During this reporting period, research was carried out in the following areas: (1) construction of a physically realistic model for the atomic arrangement around a crack tip, as well as the development of 'flexible boundaries'; (2) selection of an Fe-H interatomic potential together with its application to the simulation of hydrogen assisted crack propagation; and (3) analysis of the effects of lattice periodicity on fracture, including effects due to the presence of hydrogen. GRA

N78-12206# General Electric Co., Philadelphia, Pa. Re-entry and Environmental Systems Div.
REDEFINITION AND IMPROVEMENT OF METAL VAPOR RELEASE TECHNOLOGY Final Technical Report, Sep. 1976 - May 1977
Peter D. Zavitsanos, Fred N. Alyea, and Joseph A. Golden Griffiss AFB, N. Y. RADC Aug. 1977 18 p refs
(Contract F30602-76-C-0131)
(AD-A044538; RADC-TR-77-269) Avail: NTIS HC A02/MF A01 CSCL 07/4

This report presents the results of laboratory investigations which involved optimization studies of advanced concepts in atmospheric release technology in terms of barium vapor yield (efficiency) and increased safety. One of the most promising reactions which was identified was the reaction between Titanium and boron (in the condensed phase) to form Titanium diboride, and heat. The heat from this reaction is used to vaporize barium. Laboratory tests of the Titanium/Boron/Barium system produced a maximum yield of Barium vapor in the amount of 41.2% of the total mixture chemical weight. Author (GRA)

N78-12207# Construction Engineering Research Lab. (Army), Champaign, Ill.
CORROSION CONTROL IN CIVIL WORKS: CATHODIC PROTECTION Interim Report
F. W. Kearney Aug. 1977 70 p refs
(AD-A045184; CERL-IR-M-222) Avail: NTIS HC A04/MF A01 CSCL 13/8

This report presents the initial results of a study being conducted to mitigate corrosion in Corps of Engineers civil works structures. This phase of the study dealt with specific aspects of cathodic protection. Basic electrochemical principles and cathodic protection experiments particularly germane to civil works problems are discussed, and an innovative investigation of cathodic protection current distribution using the continuum features of electric field analysis is presented. Recently developed automatic controlled rectifiers are analyzed, and their control response measured for applications involving brackish water. Guidelines for application of cathodic protection principles to system design are also presented. Author (GRA)

N78-12208# Army Materials and Mechanics Research Center, Watertown, Mass.

THE EFFECT OF HEAT TREATMENT ON THE STRUCTURE AND PROPERTIES OF STANDARD AND MODIFIED VASCO X-2 STEEL Final Report

Paul J. Fopiano, Stephen A. Oliver, and Eric B. Kula Mar. 1977 28 p refs

(DA Proj. 1T1-62105-AH-84)

(AD-A044949; AMMRC-TR-77-8) Avail: NTIS HC A03/MF A01 CSCL 11/6

Vasco X-2 CVM is a patented high hot hardness carburizing grade gear steel. It is currently being considered for application in the next generation of Army helicopters because of its higher resistance to scuffing. Very limited metallurgical data exist for this alloy in the open literature. This paper compares the heat treatment responses of a 0.24 (standard) and 0.15 (modified) carbon Vasco X-2 steel. The effect of a wide range of austenitizing and tempering temperatures on the structure and mechanical properties is presented. The major result of the investigation indicates that by judicious choice of austenitizing and tempering heat treatments, optimum microstructure and mechanical properties can be developed for the modified Vasco X-2 steel. Rolling contact fatigue, four-square gear testing, and single tooth bending tests have been initiated to evaluate its suitability as a high performance gear material. Author (GRA)

N78-12209# Battelle Columbus Labs., Ohio.

HYDROGEN IN HY-130 WELD METAL Annual Report, Jul. 1976 - Jul. 1977

D. G. Howden and R. M. Evans 31 Jul. 1977 28 p refs

(Contract N00014-74-C-0407)

(AD-A044715; AR-3) Avail: NTIS HC A03/MF A01 CSCL 13/8

This report summarizes progress in producing evaluating welding electrodes containing known amounts of rare earth metal for reducing hydrogen embrittlement in HY-130 steel welds. Prior work indicated rare earth silicides lowered the notch strength of welds. In this report studies directed toward the use of rare earth-nickel additions as a possible means of improving this property while retaining the desirable effects of the rare earths. Results to this time indicate notch strength lowering by the rare earth-nickel also. Author (GRA)

N78-12210# Illinois Univ., Urbana-Champaign. Dept. of Metallurgy and Mining Engineering.

ON THE TECHNIQUES FOR PREPARING REFRACTORY METAL HYDROGEN ALLOYS FOR T.E.M. STUDIES

B. Makenas and H. K. Birnbaum May 1977 3 p refs

(Contract N00014-75-C-1012)

(AD-A045328) Avail: NTIS HC A02/MF A01 CSCL 11/6

The preparation of refractory metal - hydrogen alloys for T.E.M. studies has presented many experimental difficulties. It is the purpose of this note to report some of the problems encountered and to describe a successful procedure for specimen preparation. Author (GRA)

N78-12211# Office of Naval Research, London (England).

INCOMAT 1977: INTERNATIONAL CONFERENCE MARTENSITIC TRANSFORMATIONS

Jeff Perkins 11 Aug. 1977 22 p Conf. held at Kiev, (USSR), 16-19 May 1977

(AD-A045007; ONRL-C-9-77) Avail: NTIS HC A02/MF A01 CSCL 11/6

The third conference on martensitic transformations was held in Kiev in May 1977. This report presents a review of oral presentations made at the conference, generally in Russian, which provided a unique opportunity to learn of the extent of the Russian work in the field. Topics treated at this conference covered many aspects of martensite transformations: morphology of transformation; thermodynamics and kinetics of transformation; impact of lattice stability; wave propagation of nucleation; crystallography and structures; effects of deformation, dislocations, and stacking faults; shape-memory effects; and effects of stresses and strains. Author (GRA)

N78-12212# Stanford Univ., Calif. Low Temperature Physics Group.

EXPERIMENTAL EVIDENCE FOR A TEMPERATURE-DEPENDENT SURFACE SHIELDING EFFECT INSIDE A COPPER TUBE Ph.D. Thesis

James Marcus Lockhart Aug. 1977 190 p refs

(Contract F44620-75-C-0022)

(AD-A044569; AFOSR-77-1208TR) Avail: NTIS HC A09/MF A01 CSCL 20/3

The temperature dependence of the ambient axial electric field inside a vertical copper tube has been investigated. A vertical metal tube subject to the gravitational field of the Earth is expected to have spatial variations in the electrostatic potential along its axis because of contract potential differences between adjacent crystals in the metal and because of the gravitationally-induced rearrangement of the metallic electrons and ions. The result of a previous measurement by Witteborn and Fairbank (WF) of the ambient axial electric field inside a copper tube at 4.2 K is roughly four orders of magnitude too small to be consistent with the predictions of the theory of Dessler et al, and the results of several room temperature measurements. Schiff, among others, pointed out that the WF result would be consistent with the other results if a shielding effect involving electrons on the inside surface of the tube were to exist at 4.2 K but not at room temperature. In this work the electron time-of-flight method of WF was used to measure the ambient axial electric field inside a copper tube at temperatures ranging from 4.2 K to 300 K. Author (GRA)

N78-12213# Carnegie-Mellon Univ., Pittsburgh, Pa. Dept. of Metallurgy and Materials Science.

THE ROLE OF TRAPPING ON HYDROGEN TRANSPORT AND EMBRITTLEMENT Ph.D. Thesis

Gerard M. Pressouyre and I. M. Bernstein Jul. 1977 288 p refs

(Contract N00014-75-C-0265)

(AD-A045331; TR-7; CMU-036-099-7) Avail: NTIS HC A13/MF A01 CSCL 07/4

The achieved goal of the present research was to propose sets of criteria that would help in the design of alloys more resistant to hydrogen embrittlement. The research is based upon the original idea that a fine and homogeneous distribution of particular kinds of traps could achieve the above goal. This starting idea was developed from an investigation of existing hydrogen embrittlement theories, which showed that a common factor of all theories was the presence in the matrix of large deleterious accumulations of hydrogen at specific sites. Fe-Ti alloys in both the carburized and uncarburized condition were chosen as the model material to simulate internal trapping of hydrogen. Microstructure characterization revealed that all alloys consisted of a ferrite matrix in which free substitutional titanium atoms and titanium carbide particles were present. Techniques were developed to distinguish between reversible traps (titanium atoms, dislocations, grain boundaries, coherent particles) and irreversible traps (such as titanium carbide particles). This characterization separation was achieved both experimentally (using an electrochemical permeation cell) and theoretically (by proposing two new models of reversible and irreversible trapping, and by comparison with existing theories). Author (GRA)

27 NONMETALLIC MATERIALS

Includes physical, chemical, and mechanical properties of plastics, elastomers, lubricants, polymers, textiles, adhesives, and ceramic materials.

N78-12214 Florida Univ., Gainesville.
ALKALI CATION BINDING TO NONIONIC POLYMERS Ph.D. Thesis
Ronald Edward Cambron 1976 143 p
Avail: Univ. Microfilms Order No. 77-17004

The alkali cation binding of nonelectrolyte polyether type polymers in several nonaqueous solvents was measured by viscometric, spectrophotometric, potentiometric and conductance techniques. An attempt was made to correlate these findings to the ability of those polymers to catalyze nucleophilic substitution reactions to acetate salts with n-butyl bromide. Dissert. Abstr.

N78-12215 Wisconsin Univ., Madison.
POLYMER NETWORKS CROSS-LINKED IN STRAINED STATES Ph.D. Thesis
Rick Lee Carpenter 1977 237 p
Avail: Univ. Microfilms Order No. 77-14322

Linear 1,2-polybutadiene was crosslinked at various temperatures near or below the glass transition temperature by gamma irradiation while strained in simple extension, with extension ratios (lambda(o)) from 1.2 to 2.8. After release, the sample retracted to a state of ease (lambda(s)) at room temperature. From equilibrium stress-strain measurements up to a stretch ratio relative to the state of ease of 1.2, together with lambda(o) and lambda(s), the concentration of network strands terminated by trapped entanglements (v(N)) was calculated. For this purpose a 3-Constant 2-Network Theory was successfully applied. Parameters obtained from the analysis were consistent with values derived from parallel experiments of nonlinear stress relaxation of the uncrosslinked polymer, when the irradiation doses were high enough such that the entanglements were mostly trapped. Dissert. Abstr.

N78-12216 Utah Univ., Salt Lake City.
DIELECTRIC RELAXATIONS IN POLYMER SOLUTIONS Ph.D. Thesis
Ramesh Raghunath Rahalkar 1977 154 p
Avail: Univ. Microfilms Order No. 77-16810

A comparative study was made of molecular relaxation in bulk and in dilute solutions for three polymers, a polycarbonate of bisphenol A and phosgene, a copolymer of vinylidene chloride and vinyl chloride, and polypropylene oxide. The results revealed the expected relaxation rate increase with dilution. In the case of vinylidene chloride copolymer, it was also observed that there was a shift toward the single relaxation time model with increasing dilution. It was observed that the rate of solution relaxation at any given temperature increases with decreasing glass transition temperature. Although solution relaxation rates depend on frictional drag of the polymer chain against the solvent continuum as well as internal barriers to conformational change, the former contribution does not vary much among various polymer-solvent systems at the same temperature. The internal chain energetics dominate the variations in solution relaxation rate. Dissert. Abstr.

N78-12217 California Univ., Berkeley.
CLASSICAL THEORY AND CALCULATIONS OF CIRCULAR DICHROISM IN INFINITE HELICAL POLYMERS Ph.D. Thesis
Alan Isadore Levin 1976 213 p
Avail: Univ. Microfilms Order No. 77-15758

A new theory of optical activity in helical polymers is derived. Helical symmetry and periodic boundary conditions are applied to classical polarizability theory. The infinite polymer result is all order in inter-monomer interactions, and gives the polymer circular dichroism bandshape in terms of monomer transition bandshapes. While the theory is essentially equivalent to time-dependent Hartree theory, the use of empirical monomer bandshapes, rather than ab initio wavefunctions, makes calculations much more practical. This theory is applied to calculate various polynucleotide sequences. Author

N78-12218 California Univ., Berkeley.
THE DEPOSITION MECHANISM, STRUCTURE AND PHYSICAL PROPERTIES OF PLASMA POLYMERS Ph.D. Thesis
James Michael Tibbitt 1976 209 p
Avail: Univ. Microfilms Order No. 77-15882

A general mechanism for the plasma polymerization of unsaturated hydrocarbons in a flow reactor is developed. Model predictions are shown to be in good agreement with experimental deposition rate data obtained under a variety of monomer flow rates, reaction pressures and power levels. Polymers derived from an ethylene plasma contain a high density of short aliphatic branches and crosslinks and a random arrangement of double bonds and pendant aromatic rings. Structural variations effected by changes in reactions conditions are also identified. The electrical and optical behavior of solid films was studied using dynamic electrical measurements and spectroscopic techniques. Dissert. Abstr.

N78-12219# Florida Univ., Gainesville.
THE VORTEX FLOW OF DILUTE POLYMER SOLUTIONS Ph.D. Thesis
Chii-Shyoung Chiou 1976 306 p
Avail: Univ. Microfilms Order No. 77-17008

A steady three-dimensional vortex flow was used as an approximation to the actual vortex inhibition experiment. The fluid enters tangentially, spirals radially inward and exits axially at the bottom of a tank. The three dimensional velocity distribution within the vortex was determined using a photographic technique. It was found that the shearing nature of the flow field is much more important than its stretching nature which only exists in the very near vicinity of the vortex axis. Flow field measurements show that the presence of the polymer causes a dramatic change in the originally steady flow field, leading to strong flow fluctuation near the vortex axis. It is the flow fluctuation which breaks up the concentrated vortex core and results in the vortex inhibition. It is shown that the normal stress difference is of significance in suppressing the vortex formation. Dissert. Abstr.

N78-12220 California Univ., Berkeley.
INFLUENCE OF POROSITY ON THE MECHANICAL PROPERTIES OF LEAD ZIRCONATE-TITANATE CERAMICS Ph.D. Thesis
Dipak Ranjan Biswas 1976 67 p
Avail: Univ. Microfilms Order No. 77-15610

Niobium doped lead zirconate-titanate (PNZT) was used to investigate the effect of porosity on the mechanical properties of a polycrystalline ceramic. Spherical and acicular pores were introduced by using organic materials and the grain size was constant throughout the study. The very fine pores were formed by varying the sintering conditions and the grain size was comparable to the pore size. The effect of porosity on the fracture strength was predicted quite well by Weibull's probabilistic approach. The elastic modulus showed a linear relationship with increase in porosity and showed a higher value for PNZT-fine pore ceramics at same volume percent porosity. A decrease in fracture toughness with increase in porosity was also observed. It is shown that the fine pores in PNZT polycrystalline ceramic gave higher strength, elastic modulus and fracture toughness compared to the PNZT-large pore ceramics at equivalent porosites. Dissert. Abstr.

N78-12221 Materials Research Labs., Melbourne (Australia).
NON-DESTRUCTIVE EVALUATION OF THE DEGRADATION OF NYLON 6,6 PARACHUTE MATERIALS
G. A. George and N. McM. Browne Jun. 1977 29 p refs
(MRL-R-691; AR-000-660) Copyright. Avail: Issuing Activity

The changes in mechanical, physical and chemical properties of nylon 6,6 parachute canopy fabric on long term aging at 80 C are reported. The relationship between strength losses on ageing, fibre morphology, molecular weight and state of oxidation determined by chemical and spectroscopic methods, is explored. The technique of phosphorescence spectroscopy shows the greatest potential for non-destructively determining the strength losses of nylon 6,6 canopy material. A study of canopy material from PX-1 and PB-1 parachutes by this technique indicates that valid conclusions concerning strength losses on storage and use can be drawn from accelerated thermal aging. Author

N78-12222*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EFFECTIVENESS OF VARIOUS ORGANOMETALLICS AS ANTIWEAR ADDITIVES IN MINERAL OIL
Donald H. Buckley Nov. 1977 20 p refs

(NASA-TP-1096) Avail: NTIS HC A02/MF A01 CSCL 11H

Sliding friction experiments were conducted with 1045 steel contacting 302 stainless steel and lubricated with various organometallics in mineral oil. Auger emission spectroscopy was used to determine the element present in the wear contact zone. The results indicate that there are organometallics which are as effective an antiwear additives as the commonly used zinc dialkyl dithiophosphate. These include dimethyl cadmium, triphenyl lead thiomethoxide, and triphenyl tin chloride. The additives were examined in concentrations to 1 weight percent. With dimethyl cadmium at concentrations of 0.5 weight percent and above, cadmium was detected in the contact zone. Coincident with the detection of cadmium, a marked decrease in the friction coefficient was observed. All additives examined reduced friction, but only the aforementioned reduced wear to a level comparable to that observed with zinc dialkyl dithiophosphate. Author

N78-12223*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

EVALUATION OF A LOW-DENSITY POLYIMIDE FOAM IN A DYNAMIC, HIGH TEMPERATURE ENVIRONMENT

Claud M. Pittman and Ronald D. Brown Washington Dec. 1977 25 p refs

(NASA-TP-1049; L-11739) Avail: NTIS HC A02/MF A01 CSCL 11G

A low density polyimide foam material was tested in an arc tunnel to determine its potential for heat shield application on aerospace vehicles. The results show that the material has some reuse potential at surface temperatures as high as 750 K. When a black refractory paint was applied to the surface of the material, the surface recession was negligible at 750 K. An analytical thermal conductivity was derived for this material which, combined with measured thermal property values, can be used to make preliminary design thickness calculations for heat shield applications. Author

N78-12224# Dow Chemical Co., Midland, Mich.

IMPROVED INTUMESCENT PAINT Final Report, 6 May 1975 - 5 Oct. 1976

David O. Bowen and Andrew T. Graham 7 Feb. 1977 112 p refs

(Contract N00024-75-C-4427)

(AD-A044233) Avail: NTIS HC A06/MF A01 CSCL 11/3

Formulation studies using commercial Saran microspheres and halogenated latex binder led to the development of aqueous intumescent coatings. When modified with certain flame retardant additives, compositions impart excellent flame spread resistance to wood substrates. Microsphere/latex compositions modified with decabromodiphenyl oxide provide good flame insulation properties for steel panels; panel backside temperatures remained below 1000 F during flame exposure of phosphatized steel panels coated with intumescent composition. Latex/microsphere intumescent coatings show good quality and appearance when applied to wood. Further work on primer systems is needed, however, to eliminate cracking and discoloration of coatings when applied to steel panels. Author (GRA)

N78-12225# Naval Research Lab., Washington, D. C.

CARBON-13 AND PROTON NMR SPECTRA FOR CHARACTERIZING THERMOSETTING POLYMER SYSTEMS. 1: EPOXY RESINS AND CURING AGENTS Interim Report

C. F. Poranski, Jr., W. B. Moniz, D. L. Birkle, J. T. Kopfle, and S. A. Sojka 20 Jun. 1977 113 p refs

(RR0130542; WF54593201)

(AD-A044214; NRL-8092-1) Avail: NTIS HC A06/MF A01 CSCL 11/9

This report presents carbon-13 and proton nuclear magnetic resonance spectra for 24 epoxy resins and 26 curing agents. In most cases the carbon-13 resonance lines have been structurally assigned. The spectra provide data useful for the qualitative analysis of many epoxy resin systems. Author (GRA)

N78-12226# Honeywell, Inc., Bloomington, Minn. Corporate Material Sciences Center.

CRACK PROPAGATION IN PZT

J. G. Bruce and B. G. Koepke Jul. 1977 52 p refs

(Contract N00014-76-C-0625)

(AD-A044399) Avail: NTIS HC A04/MF A01 CSCL 09/1

Subcritical crack propagation in the transducer ceramic, PZT, has been studied using the double torsion technique. The effects of testing environment and temperature, as well as the state of poling in the material, have been characterized in detail. Tests run in water and in environments inert with respect to water such as toluene, mineral oil and Freon, a corona supperssant, have established that water enhances slow crack propagation in PZT. Fracture has also been found to depend sensitively on the state of poling. Crack propagation is hindered if poling is perpendicular to the crack plane but is hardly affected if the material is poled parallel to the crack. These results can be explained more in terms of the residual stresses introduced by poling than in terms of the microstructural (i.e., domain structure) changes accompanying poling. A thermal activation analysis carried out on crack propagation data measured in water on unpoled PZT yielded a stress free activation energy of 100 kcal/mol. Author (GRA)

N78-12227# Army Engineer Waterways Experiment Station, Vicksburg, Miss. Soils and Pavements Lab.

THE INFLUENCE OF POLYMERS ON THE ENGINEERING PROPERTIES OF CEMENT-STABILIZED SOIL Final Report

Jessie C. Oldham Sep. 1977 54 p refs

(DA Proj. 4A1-61101-A-91D)

(AD-A044514; WES-MP-S-77-14) Avail: NTIS HC A04/MF A01 CSCL 11/2

The objective of this investigation was to determine if engineering properties of soil-cement could be significantly improved by the addition of a relatively small amount of polymeric material. Polymer science has increased drastically over the last two decades and polymers have become increasingly useful in recent years. Composite materials using polymers have been used in several areas of engineering, and it was believed that positive results could be obtained when they were used in combination with soil-cement. Three soils were used in this investigation; a lean clay classified as CL by the Unified Soil Classification System (USCS), a fat clay classified as CH by the USCS, and a uniform grade sand classified as SP by the USCS. The stabilizers used included type I portland cement and two proprietary polymers. These two polymers were selected after a deliberate screening test involving numerous polymers. Indirect tensile and unconfined compressive tests were conducted on specimens containing 4, 6, and 8 percent portland cement plus 2 percent polymer. Results are presented showing the effects of polymers on tensile strength, compressive strength, density, tensile modulus of elasticity, and compressive modulus of elasticity. Correlations are also presented between tensile and compressive moduli of cement-treated soils. Although conclusive results cannot be determined without extensive research using other polymers and other soils, it is concluded that polymers have a tremendous effect on soil-cement, and that further research should be initiated in order that the effects of various polymers on different soil types can be more accurately defined. Author (GRA)

N78-12228# Akron Univ., Ohio. Inst. of Polymer Science.

ADHESION OF ELASTOMERS TO RIGID SUBSTRATES: THREE SUBSTRATES WITH UNEXPECTEDLY HIGH ADHESION

P. Dreyfuss, A. N. Lent, and M. L. Runge 16 Sep. 1977 17 p refs

(Contract N00014-76-C-0408)

(AD-A044451; TR-1) Avail: NTIS HC A02/MF A01 CSCL 11/10

An unexpectedly high level of adhesion has been observed for simple hydrocarbon elastomers applied to certain glassy substrates: polyphenylene oxide, polysulfone and polycarbonate. The force required to separate an elastomer layer from these substrates was more than six times larger than for other glassy substrates, e.g., polystyrene and polyethyleneterephthalate. The origin of this anomalously high adhesion is not known. Author (GRA)

N78-12229# RCA Labs., Princeton, N. J.

BASIC ADHESION MECHANISMS IN THICK AND THIN FILMS Quarterly Report, 1 Apr. - 30 Jun. 1977

Kenneth R. Bube and Thomas T. Hitch Jul. 1977 45 p refs

(Contract N00019-77-C-0176)

(AD-A044682; PRRL-77-CR-29; QR-2) Avail: NTIS

HC A03/MF A01 CSCL 11/1

This report is the second quarterly report of the fourth in a series of one-year contracts at RCA to study adhesion mechanisms in thick-film conductors. During this quarter, the sintering kinetics of a specially precipitated gold powder were examined as a function of compaction force, sintering temperature, and time, as well as glass content. It was found that ultimate gold powder densification was inversely related to powder compaction force. The previously observed retrograde sintering was judged to be due to entrapped air originally present in the compacts before sintering. Conversely, gold powder densification was found to be directly proportional to glass content. This test confirmed that liquid-phase-assisted sintering is operating in at least the first stage of sintering. With regard to mixed-bonded and reactively bonded conductors, a recent investigation of reaction Kinetics and products was critically reviewed. This review served to update and refine the nature and extent of experiments that need to be performed in this area. Proposed experiments include the elucidation of the formation of reaction products and the relationship of these products to both substrate and metal phases. Author (GRA)

N78-12230# Monsanto Research Corp., Dayton, Ohio.
FLAME- AND SMOKE-RETARDANT POLYMER SYSTEMS Interim Report, Feb. - Aug. 1977
Leo Parts, Robert D. Myers, and Norman F. May 15 Sep. 1977 40 p refs
(Contract N00024-76-C-5336)
(AD-A044857; IR-4) Avail: NTIS HC A03/MF A01 CSCL 11/9

The effort directed to the enhancement of the fire performance characteristics of molded polyvinyl chloride was continued. The effects of a latex-based intumescent paint and a mastic coating on the formation of smoke and volatile combustion products were determined. Also, flame propagation measurements were conducted with these and with other, previously prepared experimental compositions. Among the protective coatings evaluated, an alkyd-based intumescent paint exhibited best performance with regard to smoke and CO formation. This coating also contributed least to the NOx content of the combustion chamber atmosphere. Tensile strength, dielectric constant, dissipation factor and volume resistivity data are reported for the experimental fire- and smoke-retardant PVC compositions. Author (GRA)

N78-12231# Avco Systems Div., Lowell, Mass. Systems Div.
DEVELOPMENT OF OXYNITRIDE MATERIALS FOR CERAMIC TOOL BITS Final Report
Thomas Vasilos Jun. 1977 22 p refs
(Contract DAAG46-77-C-0005; DA Proj. 1T1-62105-A-1184)
(AD-A044594; AMMRC-CTR-77-17) Avail: NTIS HC A02/MF A01 CSCL 11/2

SIALON ceramic compositions were prepared by hot pressing mixtures of silicon nitride, silica and aluminum nitride. Dense microstructures were obtained and X-ray diffraction analyses were performed. Transverse bend strength measurements were performed at room temperature and 1300 C for the various compositions. Cutting tool evaluation tests were performed against hardened tool steel, cast iron and a specialty alloy Rene 41. Author (GRA)

N78-12232# Akron Univ., Ohio. Inst. of Polymer Science.
EFFECT OF INTERFACIAL CHEMICAL BONDING ON THE STRENGTH OF ADHESION OF GLASS-POLYBUTADIENE JOINTS
P. Dreyfuss, A. N. Gent, and M. L. Runge 20 Sep. 1977 23 p refs
(Contract N00014-76-C-0408)
(AD-A044505; TR-2) Avail: NTIS HC A02/MF A01 CSCL 07/4

Strong positive effects of interfacial chemical bonding on the adhesion of an elastomer layer to a glass substrate are reported. Treatment of glass slides with p-bromomethylphenylpolysiloxane led to strong adhesion with dicarboxyterminated poly-butadiene, whereas treatment with p-tolylpolysiloxane led to weak adhesion. SEM studies confirmed the presence of adhering elastomer in the former case and not in the latter. Swelling stresses were found to discriminate between relatively strongly-bonded systems of the former type, causing earlier bond failure for less firmly bonded elastomer layers. Author (GRA)

N78-12233# Air Force Materials Lab., Wright-Patterson AFB, Ohio.
THE EFFECT OF AGING ON THE GLASS TRANSITION TEMPERATURE OF SOME POLYMERS Final Technical Report, Nov. 1974 - Nov. 1975
G. F. L. Ehlers and K. R. Fisch Jun. 1977 33 p refs
(AF Proj. 7340)
(AD-A044532; AFML-TR-77-43) Avail: NTIS HC A03/MF A01 CSCL 07/3

Three polyphenylene oxides and two polyphenylquinoxalines were subjected to aging in nitrogen and in air at temperatures below and above their glass transition temperatures, and the change of Tg was determined by DSC. Tg increases of up to 70 C were observed. Formation of a second Tg, and widening of the Tg interval in one instance can be connected to the formation of new polymer species during the initial decomposition, and to the formation of crosslinked systems. The effect of aging in air was, as expected, more rigorous than aging in nitrogen. Author (GRA)

N78-12234# General Electric Co., Schenectady, N. Y.
DYNAMIC IMPACT RESPONSE BEHAVIOR OF POLYMERIC MATERIALS Final Report, 1 May 1976 - 30 Apr. 1977
William B. Hillig Aug. 1977 82 p refs
(Contract N00019-76-C-0330)
(AD-A045121) Avail: NTIS HC A05/MF A01 CSCL 11/9

The work reported was devoted to making reliable, quantitative impact pulse measurements for free-flight encounters between a spherical projectile and the desired target material. The materials of interest continue to be polycarbonate PC, polymethylmethacrylate PMMA, and epoxy resins. Inorganic glass was also used as a target material because impacts can be confidently modeled from theory in this case. Impact pulse determinations were made on the four target materials with hardened steel strikers of 4.5 mm diameter tips weighing 42 g and of 19 mm diameter weighing 28.3 g usually at 2.5 m per second. The impact strain pulse shapes are increasingly narrower and higher peaked in the order PC, epoxy, PMMA, glass. Semi-quantitative analysis of the general shapes indicates little irreversible deformation work is performed during impacts involving 19 mm striker. However, using the 4.5 mm striker causes irreversible absorption of the net energy received from the striker. The fractional amount absorbed in this series of measurements decreased in the order PC, epoxy, PMMA, and glass. Computer procedures were developed for analyzing and correcting the detailed pulse shapes to reveal how the force and penetration are related and to follow the evolution of the various energy and momentum contributions. GRA

N78-12235# Solar Turbines International, San Diego, Calif.
STUDY OF EROSION MECHANISMS OF ENGINEERING CERAMICS Interim Technical Report, 1 Apr. - 31 Jul. 1977
Mary Ellen Gulden Aug. 1977 33 p refs
(Contract N00014-73-C-0401)
(AD-A045216; RDR-1778-8; ITR-6) Avail: NTIS HC A03/MF A01 CSCL 11/2

Four 'engineering' ceramics were subjected to impact (single particle) and erosion (multiple impacts) under conditions which simulate a natural dust environment in the subsonic velocity regime. The target materials are hot pressed Si3N4, reaction bonded Si3N4, glass bonded Al2O3 and hot pressed MgF2. Tests were performed with 6 narrow size ranges of natural quartz between 10 and 385 microns average, and 5 velocities for each particle size. Hot pressed Si3N4 was also impacted with SiC under the same particle size velocity conditions. The results are discussed in terms of current erosion and impact models by considering particle size-velocity dependencies, appearance of the impact damage, and the basic properties and structure of the targets. Under these erosion conditions, the four target materials exhibited widely different behavior not only in absolute amount of material removed, but also in mechanism of removal. The systems hot pressed Si3N4-SiC particles and MgF2-quartz particles were characterized by plastic impact with associated lateral and radial crack formation, and erosion loss

was proportional to particle mass and velocity to the fourth power. Erosion of hot pressed Si3N4 impacted with quartz particles was proportional to the first power of particle size and velocity, and loss occurred by minor chipping with no secondary crack formation. Erosion of glass bonded Al2O3 and reaction bonded Si3N4 did not show a consistent particle size-velocity dependence. The variation is related to the two phase structure of these materials. GRA

28 PROPELLANTS AND FUELS

Includes rocket propellants, igniters, and oxidizers, storage and handling; and aircraft fuels.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *44 Energy Production and Conversion.*

N78-12236# Army Missile Research and Development Command, Redstone Arsenal, Ala. Propulsion Directorate.

X-RAY FLUORESCENCE ANALYSIS OF COMPOSITE PROPELLANTS FOR ARMY MISSILE SYSTEMS

Bernard J. Alley 3 Jun. 1977 168 p refs

(AD-A044686; DRDMI-TK-77-5) Avail: NTIS HC A08/MF A01 CSCL 21/9

Wavelength dispersive X-ray fluorescence spectrometric procedures were developed for the determination of ingredient percentages and average particle sizes in uncured and cured solid composite propellants of interest in Army missile systems. Three different types of propellant analyses were investigated as follows: the determination of ingredient percentages with solids particle sizes held constant; the in-situ determination of ammonium perchlorate and aluminum particle sizes with ingredient percentages held constant; and The simultaneous determination of ingredient percentages and solids particle sizes. GRA

N78-12237# Stanford Research Inst., Menlo Park, Calif.

STRUCTURE PROPERTY CORRELATIONS IN PRIMARY EXPLOSIVES Final Report, 5 Dec. 1975 - 4 Dec. 1976

Craig M. Tarver, Thomas C. Goodale, Michael Cowperthwaite, and Marion E. Hill 4 Feb. 1977 93 p refs

(Contract N00024-76-C-5329)

(AD-A044714; SRI-76-2) Avail: NTIS HC A05/MF A01 CSCL 19/1

The objective of this study was to identify the characteristics of primary explosives that account for their action as primaries by correlating their physical and chemical properties with their molecular structures. It was found that molecular structure could be correlated with properties within classes in a qualitative sense; however, quantitative data such as heats of formation and bond energies must still be developed before a firm scientific base can be established for designing molecular structure and predicting properties, as is possible for secondary explosives. Essential primary explosive properties are the ability to remain ignited and quickly undergo deflagration to detonation transition (DDT). Several practical primaries such as lead styphnate and lead azide have detectable burn times before detonation. Thus the study of DDT in cast explosives was initiated to establish whether DDT measurements were useful as a method to screen explosives for primary properties. DDT studies of two potential castable primaries, the isomers 1-methyl-5-nitrotetrazole (1MNT) and 2-methyl-5-nitrotetrazole (2-MNT) were undertaken as a first step to achieving this objective. Experiments showed that DDT occurs more readily in cast 2-MNT than in cast 1-MNT. Macek's model for DDT in cast explosives was modified in a theoretical study to provide a more realistic treatment of the accelerating flame. Times and distances for DDT in cast pentolite and crystalline lead azide were predicted and agreed well with the meager experimental data available. GRA

N78-12238# Army Armament Research and Development Command, Dover, N. J. Large Caliber Weapon Systems Lab.

PROCEEDINGS OF THE CONFERENCE ON THE STANDARDIZATION OF SAFETY AND PERFORMANCE TESTS FOR ENERGETIC MATERIALS, VOLUME 1

Louis Avrami, ed., H. J. Matsuguma, ed., and R. F. Walker Sep. 1977 590 p refs Conf. held at Dover, N. J., 21-23 Jun. 1977

(AD-A044783; ARLCD-SP-77004-Vol-1) Avail: NTIS HC A25/MF A01 CSCL 19/1

This report is a compilation of the papers presented at the Conference on the Standardization of Safety and Performance Tests for Energetic Materials which was held at ARRADCOM, Dover, N.J. on 21-23 June 1977. Author (GRA)

N78-12239# Pennsylvania State Univ., University Park. Dept. of Mechanical Engineering.

TRANSIENT COMBUSTION IN GRANULAR PROPELLANT BEDS. PART 1: THEORETICAL MODELING AND NUMERICAL SOLUTION OF TRANSIENT COMBUSTION PROCESSES IN MOBILE GRANULAR PROPELLANT BEDS Final Report, 15 Feb. 1974 - 14 Feb. 1977

J. H. Koo and K. K. Kuo Aug. 1977 179 p refs

(Grant DAAG29-74-G-0116)

(AD-A044998; BRL-CR-346-Pt-1) Avail: NTIS HC A09/MF A01 CSCL 19/1

Gas-permeable propellants possess great potential for producing sizable thrusts within extremely short time intervals. A research program was set up with the objectives: (1) to obtain a deeper understanding of high speed flame propagation and the gas dynamic behavior of two-phase reactive flow systems; and (2) to predict the rates of gasification during transient heterogeneous combustion of granular propellant beds. The results show that the flame front accelerates significantly and the rate of pressurization increases substantially in the downstream direction. The igniter strength and the propellant gasification temperature were found to have pronounced effects on the pressurization process. The theoretical predictions are in close agreement with the experimental data. GRA

N78-12240# Pennsylvania State Univ., University Park. Dept. of Mechanical Engineering.

TRANSIENT COMBUSTION IN GRANULAR PROPELLANT BEDS. PART 2: EXPERIMENTAL STUDY OF TRANSIENT COMBUSTION PROCESSES IN MOBILE GRANULAR PROPELLANT BEDS Final Report, 15 Feb. 1974 - 14 Feb. 1977

T. R. Davis and K. K. Kuo Aug. 1977 88 p refs

(Grant DAAG29-74-G-0116)

(AD-A045001; BRL-CR-347-Pt-2) Avail: NTIS HC A05/MF A01 CSCL 19/1

Catastrophic failure of propulsion and gun systems has been attributed to abnormal combustion within granular propellant charges. The effects of igniter strength, propellant type, deterrent concentration, and projectile motion on the overall transient combustion process in granular propellant beds were studied experimentally. The results show that igniter strength significantly affects the duration of the induction period, and also the accelerative behavior of the pressure front traveling through the bed; a weaker igniter causes a more pronounced pressure front acceleration. A large igniter volume was found to reduce the rate of flame spreading and pressurization processes. Combustion of slightly deterred propellants produced extremely rapid flame spreading, higher peak pressures, and higher pressurization rates than regularly deterred propellants. Propellant particle geometry was found to greatly affect the rate of total mass consumption within a propellant bed and thereby influence the peak pressures and pressure wave phenomena within the bed. Author (GRA)

N78-12241# Battelle Columbus Labs., Ohio.

DEVELOPMENT OF A SIMPLE PORTABLE DETECTION KIT FOR SELECTED EXPLOSIVES Final Report, 19 Jun. 1975 - 31 Dec. 1976

Robert E. Wyant Sep. 1977 69 p

(Contract N00174-75-C-0277)

(AD-A045000; NAVEODFAC-TR-185) Avail: NTIS HC A04/MF A01 CSCL 19/1

An explosive detection spray system has been developed which will detect explosive residues on the exterior of letter and package bombs. The detection is through the formation of colored reaction products using select spray reagents. Reagents were screened for shelf life and toxicity. The wavelength of absorbence and absorptivity of the reagent explosive complex

was determined. The spray reagent of choice capable of detecting 0.4 micrograms TNT is prepared by adding 5 grams 1,3-diphenylacetone and 5 milliliters 20 percent tetracethylammonium hydroxide in methanol to 100 milliliters ethanol. RDX and Nitrate esters are detected at the 0.4 microgram level by spraying the substrate with a suspension of 10 grams of zinc dust in benezene, followed by a solution of 0.35 grams of procaine and 0.35 grams N,N-dimethyl-1-naphthylamine in 100 milliliters of a 50/50 acetic acid/distilled water mixture. Author (GRA)

N78-12242# California Univ., Livermore. Lawrence Livermore Lab.
MEASURING SMALL INTERNAL PRESSURES ALONG A TUBE DURING STEADY FLOW
H. S. Freynik and G. R. Dittbenner 16 Mar. 1977 23 p refs Presented at a Meeting of the Soc. for Exptl. Stress Analysis, Washington, D.C., 9-14 May 1976
(Contract W-7405-eng-48)
(UCRL-77305-Rev-1) Avail: NTIS HC A02/MF A01

A tube that can accurately measure small stains and pressure profiles during flow of non-Newtonian paste explosives was designed and strain gaged. Equiangular rosette strain gages were installed along the length of a 6 mm dia, 0.46 m long thin-walled aluminum tube. The rosettes were oriented in the classical stress gage configuration to measure circumferential stress and hence internal pressure independent of other stresses. The tube was static calibrated on a floating piston pressure calibrator. Steady flow calibration was accomplished by extruding a viscous Newtonian silicone oil. Inlet pressure ranged from 0.52 to 2.1 MPa (75 to 300 psi). For the low pressure 0.52-MPa silicone oil extrusion, the full scale strain levels varied from 6 to 53 micron/m. For all eight strain gage stations, the maximum deviation from a linear pressure profile was equivalent to 0.5 micron/m. A pulsed current excitation signal conditioning and digital data acquisition system provided the necessary stability and precision to measure these unusually low strain levels accurately. ERA

N78-12243# Transportation Systems Center, Cambridge, Mass.
METHANOL AS AN AUTOMOTIVE FUEL WITH SPECIAL EMPHASIS ON METHANOL-GASOLINE BLENDS Final Report, Jun. - Oct. 1974
A. Landman Apr. 1977 89 p refs
(PB-270401/3; DOT-TSC-OST-74-38; DOT-TSC-OST-77-31) Avail: NTIS HC A05/MF A01 CSCL 21D

Methanol is characterized and the results of various studies on methanol and methanol-gasoline blends, and their use and effects in engines and vehicles are presented and compared. Cost information, although limited, is given as available. Methanol production processes are described as well as their promise and expansion possibilities in relation to potential requirements. Various raw material sources are considered in the light of future production potential needs. GRA

N78-12244# Federal Energy Administration, Washington, D. C. Office of Energy Resource Development.
FUTURE REFINERY CAPACITY NEEDS, CONSTRUCTION INCENTIVES, AND PROCESSING CONFIGURATIONS
22 Jul. 1977 57 p
(PB-271099; FEA/G-77/235) Avail: NTIS HC A04/MF A01 CSCL 21D

Planned additions to the capacity of U.S. oil refineries will exceed the expansion needed by 1985 to meet the goals of the National Energy Plan. However, because of difficulties associated with obtaining permits, not all of these planned additions may be achieved. Noting that the plan will result in a reduction in demand for residual fuel oil from 3.5 million barrels to 2.0 million barrels per day, the report observes that overall capacity growth requirements will be reduced, and addition of 1 million barrels per day would suffice to meet 1985 demand at reasonable upper limits of refinery utilization. Other topics explored include production incentives such as the entitlements program, import fees, crude equalization taxes, investment tax credits and accelerated depreciation. Projected changes in refinery configuration involving hydrocracking, coking, vacuum distillation and cat cracking are also discussed. Author

N78-12245# Bureau of Mines, Washington, D. C. Div. of Interfuels Studies.
FUELS AND ENERGY DATA: UNITED STATES BY STATES AND CENSUS DIVISIONS, 1974
Lulie H. Crump Dec. 1976 171 p refs
(PB-271093/7; BM-IC-8739) Avail: NTIS HC A08/MF A01 CSCL 21D

Salient information on reserves, production, and consumption of fuels and energy by state is summarized. Reserve and production data are shown for each of the fossil fuels (coal, crude oil, natural gas liquids, and natural gas) and for uranium. The consumption data of each of the major consuming sectors (household-commercial, industrial, transportation, electric power, and miscellaneous) are broken down by energy source (coal, petroleum, natural gas, hydropower, and nuclear). In addition, total energy consumption in the nation in 1974 is compared with consumption in 1973 and 1975. GRA

N78-12246# Consolidation Coal Co., Library, Pa. Research Div.
HIGH-TEMPERATURE DESULFURIZATION OF LOW-Btu-GAS Final Report, Jul. 1973 - Jan. 1976
G. P. Curran, B. J. Pasek, M. Pell, and E. Gorin Apr. 1977 361 p refs
(Contract EPA-68-02-1333)
(PB-271008/5; EPA-600/7-77-031) Avail: NTIS HC A16/MF A01 CSCL 21D

Results of economic studies of a process for desulfurizing low-Btu fuel gas are described and studied. The gas is first desulfurized at high temperature in a fluidized bed of half calcined dolomite. It is then cooled to 700 C and passed through high pressure drop cyclones to remove particulates and alkali. The gas is intended for use as fuel to gas turbines in combined-cycle power generation. The sulfur acceptor is regenerated with steam and CO2. A liquid phase Claus reactor is used to process H2S in the regenerator offgas into elemental sulfur. Experimental data are presented in several areas: (1) desulfurization and regeneration activity of dolomites as a function of cycles; (2) batch studies to determine variable effects and rate data; (3) particulate and alkali removal at high temperature; (4) chance reaction studies; and (5) process improvement studies. GRA

N78-12247# Federal Energy Administration, Washington, D. C. Office of Price Regulations.
CUMULATIVE PRODUCTION/CONSUMPTION EFFECTS OF THE CRUDE OIL PRICE INCENTIVE RULEMAKINGS Draft Environmental Impact Statement
Aug. 1977 640 p refs
(PB-271319/6; FEA/H-77/333; DES-77/7) Avail: NTIS HC A99/MF A01 CSCL 21D

An Environmental Impact Statement which analyzes the effect of Stage II of the EPCA crude oil price regulations is presented. The proposed regulations provide for monthly upward adjustments of the composite price, beginning in March 1976, to take into account the effects of inflation and to provide additional production incentives. It also analyzes the effect of the ECPA, which exempted stripper well oil from price controls and provides for special price treatment for heavy gravity crude oil produced in California and Alaska. GRA

31 ENGINEERING (GENERAL)

Includes vacuum technology; control engineering; display engineering; and cryogenics.

N78-12248# Naval Ship Research and Development Center, Bethesda, Md.
STATIC STABILITY CHARACTERISTICS OF A SYSTEMATIC SERIES OF STERN CONTROL SURFACES ON A BODY OF REVOLUTION Final Report
Elizabeth M. Dempsey Aug. 1977 84 p refs
(SR0230101)
(AD-A044763; DTNSRDC-77-0085) Avail: NTIS HC A05/MF A01 CSCL 13/10

Experiments were conducted to determine the forces and moments due to angle of attack on a representative streamlined body of revolution alternately appended with members of a systematic series of stern control surfaces. The data from these

experiments are presented in the report in the form of graphs and tabulations of the nondimensional force and moment coefficients and static stability derivatives. Based on these data empirical mathematical expressions have been developed to predict the contribution of sternplanes to the static stability derivative Zw: when the sternplanes are appended to a submarine whose basic hull is a streamlined body of revolution. A graph is presented for estimating the location of the center of pressure of the forces due to the presence of sternplanes. Author (GRA)

N78-12249# ARO, Inc., Arnold Air Force Station, Tenn.
TRANSMISSION OF INFRARED MATERIALS AND CONDENSED GASES AT CRYOGENIC TEMPERATURES Final Report, 26 Jul. 1973 - 30 Jun. 1975
J. G. Pipes, J. A. Roux, A. M. Smith, and H. E. Scott AEDC Sep. 1977 292 p refs
(AD-A044517; ARO-VKF-tr-75-108; AEDC-TR-77-71) Avail: NTIS HC A13/MF A01 CSCL 20/6

An infrared optical transmission chamber was developed to measure the spectral transmission of cryogenically cooled (20 K and 80 K) optical windows, filters, etc., both with and without cryodeposit contamination. An FTS-14 Interferometer Spectrometer recorded transmission measurements for 20 and 80 K germanium windows both clean and with the following contaminants condensed on them: NH3, CO2, CO, CH4, HC1, and air. These measurements were made for many different contaminant thicknesses. From 20 and 80 K data the optical constants (complex refractive index) for NH3 were determined. Further, the transmission measurement of 20 and 80 K polystyrene was recorded and showed that the standard absorption bands observed at 300 K not shift in wavenumber more than 1/cm when the polystyrene is cooled to 20 K. Hence, polystyrene is a reliable wavelength calibrator when used at 20 K. Author (GRA)

N78-12250# Pennsylvania State Univ., University Park. Applied Research Lab.
A THIRD PROCEDURE FOR LINEARIZED FULLY CAVITATING HYDROFOIL SECTION DESIGN
B. R. Parkin and J. Fernandez 5 Jul. 1977 212 p refs
(Contract N00017-73-C-1418)
(AD-A044784; TM-77-186) Avail: NTIS HC A10/MF A01 CSCL 20/4

The third design procedure for fully cavitating hydrofoils is based upon a linearized inverse theory of two-dimensional capacity flows at arbitrary cavitation number. The cavity surfaces are assumed to originate at the leading and trailing edges of the wetted surface. This report reviews and completes the basic theory and gives detailed examples obtained from the resulting parametric design technique. In the third design procedure, one specifies the design lift coefficient, the cavitation number and the upper cavity thickness at two points along the profile chord. A prescribed pressure distribution shape is also selected. The method also includes off-design calculations in accordance with the direct linearized theory of cavity flows which determines the flow states for which interference can occur between the upper surface of the cavity and the upper nonwetted surface of the profile. The hydrodynamic performance of specific point designs is also given by these direct calculations. The chief new feature of the third design procedure is the ability of the designer to prescribe two points on the cavity surface instead of one as heretofore. GRA

N78-12251# Naval Ship Research and Development Center, Bethesda, Md. Aviation and Surface Effects Dept.
CIRCULATION CONTROL: AN UPDATED BIBLIOGRAPHY OF DTNSRDC RESEARCH AND SELECTED OUTSIDE REFERENCES Report, Jan. 1969 - Jun. 1977
Robert J. Englar, Michael B. Stone, and Marion Hall Sep. 1977 38 p refs
(f41421210)
(AD-A044762; AERO-1234; DTNSRDC-77-0076) Avail: NTIS HC A03/MF A01 CSCL 01/3

This report is an update of a previously published bibliography of technical notes, formal reports, and technical papers by personnel of the Aviation and Surface Effects Department, David W. Taylor Naval Ship Research and Development Center (DTNSRDC). The update covers publication in the time period from the beginning of 1969 through mid-1977. The citations are arranged chronologically and represent the technology of circulation control as it has developed at DTNSRDC. This report also contains appendices of selected outside references which are pertinent to circulation control. Author (GRA)

N78-12252# Battelle Columbus Labs., Ohio.
A PLASMA FLAME SPRAY HANDBOOK Final Report
T. J. Roseberry and F. W. Boulger Mar. 1977 169 p refs
(Contract N00197-73-C-4030)
(AD-A044618; NAVSEA-MT-043) Avail: NTIS HC A08/MF A01 CSCL 13/8

The Plasma Spraying process is a versatile fabrication technique used to apply a wide range of coatings on various workpiece materials. Coatings are applied to restore or attain desired dimensions, to provide electrical or thermal shielding or conduction, or to improve the resistance to abrasion, corrosion, or high temperatures. Success in meeting intended goals by Plasma Spraying depends on selecting an appropriate coating material and using cleaning and spraying techniques suitable for the materials involved. This report provides useful, up-to-date information about Plasma Spraying both metallic and nonmetallic coatings on steel and bronze. It discusses the principles and details the procedures suitable for producing high-quality coatings destined for severe service applications of interest to the U. S. Navy. This handbook should be considered a guide, not a bible, for planners, designers, and production personnel responsible for choosing, applying, and evaluating plasma-arc sprayed coatings. Limitations on space and reliable information, and the variety of types and applications of coatings, prevented covering some aspects of plasma spraying in detail. For such reasons, differences in the types of plasma-spray systems used successfully, limiting coating thickness, and effects of specific part geometries are not covered comprehensively. Most of the information in the handbook is directed to engineers overseeing and developing expertise in plasma-arc spraying. The handbook is based on experience, published information, and experimental data generated on this program. GRA

N78-12253# Stanford Univ., Calif. Dept. of Physics.
FUNDAMENTAL EXPERIMENTS AT LIQUID HELIUM TEMPERATURES Annual Report, 1 Oct. 1975 - 30 Sep. 1976
William M. Fairbank and John M. J. Madey Aug. 1977 70 p refs
(Contract F44620-75-C-0022)
(AD-A044568; AFOSR-77-1207TR) Avail: NTIS HC A04/MF A01 CSCL 20/13

During the past contract year important new results have been obtained in the surface shielding experiment and in the polarized He(3) experiment. In this period the temperature transition in the anomalous surface shielding effect was discovered and investigated. A complete report/thesis was written covering all the shielding effect work to date. In the polarized He(3) experiment measurements were made of the longitudinal nuclear relaxation times of dilute mixtures of polarized He(3) in liquid He(4) molar concentrations of 7 x 10(-3) at 4.2 K in magnetic fields between 36 x10(-6)G and 2 mG in order to search for techniques which would allow the achievement of very long relaxation times. By using a solid H(2) wall coating in a 1-cm diameter cell, a relaxation time in excess of five days was obtained. Fabrication of all internal components of the prototype electron/positron thermalizer was completed during the past contract year. The central apparatus was assembled and wired. A laboratory was equipped, necessary cyrogenic and vacuum equipment was constructed, and preparations were made for low temperature runs of the thermalizer prototype during the 1976-77 contract year. Author (GRA)

N78-12254# Brookhaven National Lab., Upton, N. Y.
EFFECTS OF MEASUREMENT ERRORS ON LINEAR CALIBRATION EQUATIONS
Sylvester C. Suda and Donald F. Shepard, (Atlantic Richfield Hanford Co.) Jul. 1976 66 p refs
(Contract EY-76-C-02-0016)
(BNL-50432) Avail: NTIS HC A04/MF A01

The effects of measurement errors in both the dependent and independent variables in linear calibrations were studied by examining; (1) a simulation model in which the lack of fit was

zero with assigned known values of the measurement errors; (2) data from a laboratory calibration of a process vessel where the measurement errors are small compared to the lack of fit; (3) data from a process vessel calibration where the lack of fit can be removed through the use of a cubic equation; and (4) data from a process vessel calibration where the major error appears to be in the dependent variable. The effect of measurement errors on the estimation of the standard deviation of the slope was found to be highly dependent on the experimental design used and on the subsequent treatment of the data. ERA

N78-12255# Michigan Dept. of State Highways and Transportation, Lansing. Testing and Research Div.
DETERMINATION AND IMPROVEMENT OF RELEVANT PAVEMENT SKID COEFFICIENTS Final Report, Jul. 1970 - Jun. 1975
F. Copple and P. T. Luce Jan. 1977 52 p refs
(PB-269862/9; R-1038; FHWA-R-1038) Avail: NTIS HC A04/MF A01 CSCL 13F

Coefficients of wet pavement friction were measured. The investigation included tests at speeds up to 77 mph, use of smooth test tires, and measurement of wet peak friction. Skid test locations included varied surface types and textures on both traveled and untraveled roadways, and skid testing was performed during all seasons. Specific findings include: stopping distances on wet highways for a vehicle with smooth tires average 50% greater and may be over 150% greater than a vehicle with treaded tires; friction tests made with smooth tires provide a valuable tool for evaluating pavement textures; and friction values for a given test speed may be reliably estimated from values measured at lower speeds. GRA

N78-12256# North Carolina State Univ., Raleigh. Dept. of Civil Engineering.
STRUCTURAL DESIGN WITH HIGH STRENGTH CONCRETE Final Report
Paul Zia Mar. 1977 74 p refs
(Grant NSF GK-40008)
(PB-270215/7; PZIA-77-01) Avail: NTIS HC A04/MF A01 CSCL 13C

Parametric studies were carried out to develop quantitative information with respect to the strength and behavior of reinforced and prestressed concrete beams and beam-columns as affected by the use of high strength concrete along with high strength reinforcement. The concrete strength is varied from 5 ksi, to 25 ksi, and three levels of steel stress (80 ksi 100 ksi, 120 ksi) are used. For prestressed concrete members, only the 270K grade prestressing strand was considered. Special emphasis was placed upon the current design criteria in order to identify the possible limitations of these criteria which could prevent the effective use of high strength concrete. GRA

N78-12257# Utah Dept. of Transportation, Salt Lake City. Materials and Research Section.
PREDICTING THE 28-DAY STRENGTH OF PORTLAND CEMENT CONCRETE BY NUCLEAR DENSITIES Final Report
Joseph C. McBride Nov. 1976 31 p refs Sponsored by Federal Highway Admin.
(PB-270311/4; UDOT-MR-77-1) Avail: NTIS HC A03/MF A01 CSCL 13C

A preliminary investigation into the possible use of concrete nuclear densities as a substitute for 28-day concrete specifications is reported. During the investigation five variables (slump, entrained air, cylinder strength, core strength and nuclear density) were evaluated which indicated that there existed a high correlation between cylinder strength, core strength and nuclear density. The confidence limits were too great to allow nuclear density readings to replace the 28-day cylinder strength requirements. The study recommended further research to incorporate a density requirement as a construction control of consolidation and not of concrete strength. GRA

32 COMMUNICATIONS

Includes land and global communications; communications theory; and optical communications.

For related information see also *04 Aircraft Communications and Navigation* and *17 Spacecraft Communications, Command and Tracking*.

N78-12258 Missouri Univ., Columbia.
STATISTICAL ANALYSIS AND RELIABILITY OF WIDEBAND RADIO COMMUNICATION LINKS ON THE BASIS OF STRIP CHART DATA Ph.D. Thesis
Surachai Suthasinekul 1976 230 p
Avail: Univ. Microfilms Order No. 77-15556

Statistical analysis of wideband radio communication links utilizing line-of-sight and tropospheric scatter as the transmission means is investigated. A simplified model of a wideband communication link is proposed describing the basic concept in wideband radio communications. Several performance parameters and the components of the impairment are illustrated in the model. Dissert. Abstr.

N78-12259 Southern Illinois Univ., Carbondale.
SURFACE IMPEDANCE CONCEPT AND ITS APPLICATION TO ELECTROMAGNETIC GUIDED WAVE PROPAGATION Ph.D. Thesis
Prabha Narendra Kumar 1976 257 p
Avail: Univ. Microfilms Order No. 77-16630

Some problems are considered in electromagnetic theory where the surface impedance concept has been applied to guided wave propagation. In Chapter 1, an extensive study of the relevant literature was reviewed and analyzed in detail. Propagation between two parallel planes with two impedances suggests many more possibilities. In Chapter 2, the problems pertaining to propagation between two parallel planes is discussed in detail. In Chapter 3, analysis of the modes in cylindrical domain with reactive impedance wall is made. In Chapter 4 first some of the important work on periodic structure was analyzed and reviewed. In Chapter 5, several propagation characteristics associated with modes in cylindrical structure with constant surface impedance and when the surface impedance is a function of wave number are computed. Dissert. Abstr.

N78-12260*# ECON, Inc., Princeton, N. J.
A STUDY OF WORLDWIDE COMMUNICATIONS MARKETS: THE RELATIONSHIP BETWEEN FEDERALLY SPONSORED RESEARCH AND DEVELOPMENT AND COMPETITVENESS OF US INDUSTRY IN THIS MARKET
12 Apr. 1977 128 p refs
(Contract NASw-3047)
(NASA-CR-155324; Rept-77-263-3) Avail: NTIS HC A07/MF A01 CSCL 17B

Many factors have been reviewed in an attempt to seek criteria for the establishment of regions or nations as potential customers for space communication systems. These include economic measures, demographic distributions, topographic variations, physical size, national dispersion, telephones available, investment credit viability, and the general level of technology within the population. A major consideration is the fact that essentially all nations are subject to significant financial constraints. Consequently, some form of national investment priorities becomes necessary, and these priorities are generally perceived differently according to the factors mentioned above and also according to the personalities and interests of each nation's decision makers. Author

N78-12261*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SHARING THE 620-790 MHz BAND ALLOCATED TO TERRESTRIAL TELEVISION WITH AN AUDIO-BANDWIDTH SOCIAL SERVICE SATELLITE SYSTEM Final Report
Ernest K. Smith and E. E. Reinhart 31 Oct. 1977 104 p refs Sponsored in part by HEW
(Contract NAS7-100)
(NASA-CR-155268; JPL-Pub-77-71) Avail: NTIS HC A06/MF A01 CSCL 17B

A study was carried out to identify the optimum uplink and downlink frequencies for audio-bandwidth channels for use by a

satellite system distributing social services. The study considered functional-user-need models for five types of social services and identified a general baseline system that is appropriate for most of them. Technical aspects and costs of this system and of the frequency bands that it might use were reviewed, leading to the identification of the 620-790 MHz band as a perferred candidate for both uplink and downlink transmissions for nonmobile applications. The study also led to some ideas as to how to configure the satellite system. Author

N78-12262# Speech Communications Research Lab., Inc., Santa Barbara, Calif.

FEATURE ANALYSIS FOR SPEAKER IDENTIFICATION Final Report

Larry L. Pfeifer Aug. 1977 93 p refs
(Contract F0602-76-C-0157)
(AD-A044311; RADC-TR-77-277) Avail: NTIS HC A05/MF A01 CSCL 05/7

A method for text-independent speaker identification has been developed which utilizes vowel sounds as the basis for extracting speaker characteristics. The use of this approach typically requires that vowel samples first be classified according to vowel category, so that vowels of the same category can be compared in the speaker identification process. It has been demonstrated, however, that it is only necessary to detect vowel-like sounds in the speech material and that speaker identification performance actually improves when there is no vowel recognition. Another significant outcome of this research was the successful application of sequential analysis to the decision process. The experiments which led to the conclusions of the research were based upon a data base of vowel samples form more than one hour of speech material excerpted from conversational speech recordings. Using the sample 20-speaker reference patterns, tests with data from two speakers recorded two weeks after the reference material showed that one of the speakers was correctly identified in 18 seconds and the second speaker was correctly identified, but with a lower confidence level than the first. GRA

N78-12263# Rome Air Development Center, Griffiss AFB, N.Y. Dept. of Electronic Technology.

VLF/LF REFLECTIVITY OF THE POLAR IONOSPHERE, 1 AUGUST 1976 - 1 JANUARY 1977

John E. Rasmussen, John P. Turtle, Robert P. Pagliarulo, and Wayne I. Klemetti Apr. 1977 105 p refs
(AD-A044050; RADC-TR-77-141) Avail: NTIS MF A01 CSCL 20/14

This report provides a summary of high latitude ionospheric reflectivity as observed by the USAF high resolution VLF/LF ionosounder operating in northern Greenland. Ionospheric reflectivity parameters, including reflection heights and coefficients, are presented as a function of time of day. VLF long path propagation measurements, along with magnetometer and riometer data, are presented as supplementary information. Author (GRA)

N78-12264# University Coll., London (England). Dept. of Statistics and Computer Science.

UNIVERSITY COLLEGE LONDON ARPANET PROJECT Annual Report, 1 Jan. - 31 Dec. 1976

Peter T. Kirstein Feb. 1977 189 p refs
(Contract N00014-74-C-0280; Grant N00014-77-G-0005)
(AD-A044419; TR-34) Avail: NTIS HC A09/MF A01 CSCL 17/2

Research activities covered in this document include the interconnection of hosts and networks, the development of a system SWITCH for virtual network connection, and our connction to the UK Post Office Experimental Packet Switched Service. Two topics covered in particular detail are the packet satellite project and the Transmission Control Program (TCP) experiments. These have particular relevance to other ARPA supported projects and so are treated in space depth. Finally, our measurement and facsimile activities are described, and UK use of ARPANET through the ULC TIP is evaluated. A list of conclusions that may be drawn from our research activities during 1976 is given at the end of the report. Author (GRA)

N78-12265# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.

A FEASIBILITY STUDY OF VERY LOW RATE SPEECH COMPRESSION SYSTEMS Final Report, 19 Jul. 1976 - 18 Jan. 1977

J. Makhoul, R. Schwartz, C. Cook, and D. Klatt Feb. 1977 59 p refs
(Contract MDA903-75-C-0180; ARPA Order 3253)
(AD-A044400; BBN-3508) Avail: NTIS MF A01 CSCL 17/2

This report documents the results of a feasibility study for very low rate speech compression systems. Two systems were implemented: (1) A variable rate, hybrid formant-LPC vocoder transmitting at an average of 500 bps, and (2) a phonetic vocoder transmitting at an average rate of 75 bps. The intelligibility of the 500 bps system was judged to be high, but with a loss in naturalness and speaker identifiability. The 75 bps system utilized a phonetic recognition program and transmitted phonemes, pitch and duration. The synthesis at the receiver was performed using a synthesis-by-rule program, with a resulting good intelligibility but machine-like quality. In a listener judgment experiment of the vocoder, a recognition accuracy of over 80% was deemed necessary for communication purposes. A study was then undertaken to determine the feasibility of a real-time 75 bps vocoder. It was concluded that such a system was indeed feasible, with over 80% phonetic recognition, natural sounding synthesis, and real-time operation using off-the-shelf technology. Author (GRA)

N78-12266# Armed Forces Communications and Electronics Association, Eatontown, N. J.

PROCEEDINGS OF THE 2ND ANNUAL SEMINAR ON THE ART OF COMMUNICATION INTERFACES

Seymour Krevsky 15 Sep. 1977 142 p refs Seminar held at Eaton, N. J., 15 Sep. 1977
(AD-A044407; AFCEA-FM-2) Avail: NTIS HC A07/MF A01 CSCL 17/2

Nine technical papers on important aspects of strategic and tactical communications systems interfaces are presented by leading authorities on technical and operational aspects of importance to National Defense. More than ever these interfaces are crucial to the timely and accurate transmission of highly sensitive command, control and intelligence information needed to win battles and wars. This is true for the peacetime detente situation as it is for the hot war armageddon. Author (GRA)

N78-12267# Lincoln Lab., Mass. Inst. of Tech., Lexington.

WAVEFORM AND CLUTTER FILTER DESIGN FOR A SATELLITE-BORNE BISTATIC RADAR FOR AIRCRAFT DETECTION

Robert A. Groundry and Chester J. Kurys 28 Jun. 1977 151 p refs
(Contract F19628-76-C-0002; ARPA Order 600)
(AD-A044309; TN-1977-7; ESD-TR-77-169) Avail: NTIS HC A08/MF A01 CSCL 17/9

Waveform and clutter filtering for the detection of moving aircraft in the presence of ground clutter by a spaceborne bistatic radar are described. The waveform designs are based on mappings of the aircraft and clutter onto the bistatic range-Doppler plane. Low sidelobe digital filter designs for the required clutter rejection, coverage characteristics of a bistatic radar on representative satellite orbits, and system requirements for a North American surveillance fence for bomber detection are included. Author (GRA)

N78-12268# Naval Research Lab., Washington, D. C.

HIGH-RESOLUTION RADAR SCATTERING CHARACTERISTICS OF A DISTURBED SEA SURFACE AND FLOATING DEBRIS Interim Report

Bernard L. Lewis, James P. Hansen, Irwin D. Olin, and Vincent Cavaleri 29 Jul. 1977 47 p refs
(SF1214141B)
(AD-A044216; NRL-8131) Avail: NTIS HC A03/MF A01 CSCL 17/4

A study was made of high-resolution radar returns from a disturbed sea surface and from rigid debris floating on such a surface. The goal was to determine if there are differences between the scatter from the sea and that from debris that would permit sea return to be suppressed and debris return to be detected. The study involved both theoretical and experimental efforts. Measurement revealed that sea return was relatively improbable in any given resolution cell and that when it did occur it lasted only a second or two. Also, such return was always heavily

amplitude modulated with modulation frequencies much higher than those on debris echoes. These findings were explained theoretically and used in developing a debris-avoidance radar concept for high-speed ships. Author (GRA)

N78-12269# Sperry Rand Research Center, Sudbury, Mass.
OPTOSWITCH CROSSTALK STUDY Final Technical Report, Feb. 1976 - Mar. 1977
Richard A. Soref Griffiss AFB, N. Y. RADC Aug. 1977 138 p refs
(Contract F30602-76-C-0129)
(AD-A044208; SCRC-CR-77-22; RADC-TR-77-260) Avail: NTIS HC A07/MF A01 CSCL 17/2

A multimode electro-optical switch that has low crosstalk between channels has been demonstrated experimentally in a 70-micrometers-thick plate of Z-cut LiTaO3. The fiber-compatible four-port switch is intended for integration into an optical matrix. The crosspoint consists of an in-plane crossover, two simple optical switches, and a curved connecting waveguide. Taken alone, the crossovers had 40 dB optical isolation. Compound crosspoints were tested using convergent TM-polarized input light with an 0.07 numerical aperture. About 10% of the initially channeled light was transferred into the crosschannel, and the optical switching ratio of the crosschannel was 26 dB using 450 volts dc for control. Optical transmission loss of the 6-cm-long switch was 1.6 dB. Author (GRA)

N78-12270# RAND Corp., Santa Monica, Calif.
INTERPROCESS COMMUNICATION EXTENSIONS FOR THE UNIX OPERATING SYSTEM. 1: DESIGN CONSIDERATIONS Interim Report
Carl A. Sunshine Jun. 1977 40 p refs
(Contract F49620-77-C-0023)
(AD-A044200; R-2064/1-AF) Avail: NTIS HC A03/MF A01 CSCL 17/2

The UNIX operating system for the PDP-11 series of minicomputers has gained wide popularity in academic and government circles. This report considers interprocess communication (IPC) facilities with the goal of developing an improved IPC capability for UNIX. An outline of the major issues involved in providing IPC is developed based on a survey of the literature, and UNIX IPC facilities are described in terms of this outline. By considering new applications being developed under UNIX, several shortcomings in the standard IPC facilities are identified, including the inability of 'unrelated' processes to communicate, the inability to wait for multiple inputs, and primitive synchronization facilities. Techniques to provide desirable improvements are suggested, including named ports, message ports, improved signals, and message facilities. Ports appear to have the highest benefit/cost ratio, and their implementation is described in a companion report, R-2064/2-AF. Author (GRA)

N78-12271# Lincoln Lab., Mass. Inst. of Tech., Lexington.
INFORMATION PROCESSING TECHNIQUES PROGRAM. VOLUME 2: COMMUNICATIONS-ADAPTIVE INTERNETTING Semiannual Technical Summary, 1 Jul. 1976 - 31 Mar. 1977
Bernard Gold 31 Mar. 1977 31 p refs
(Contract F19628-76-C-0002; ARPA Order 2929)
(AD-A044071; ESD-TR-77-187-Vol-2) Avail: NTIS HC A03/MF A01 CSCL 17/2

The goal of this program is the investigation and development of techniques for communications-adaptive internetting with particular emphasis on digital voice communications. The specific class of problems addressed relates to packet speech networks whose interconnecting links may be stressed as a result of traffic overloads or are time varying due to natural or hostile actions. This program extends the technology of fixed-topology packet-switching speech communications networks by introducing techniques for adapting both source encoder algorithms and network utilization strategies to the time-varying character of the links in an attempt to provide sustained voice communications capability under adverse conditions. The major accomplishments of the past nine months are: (A) Variable-Data-Rate Protocols for C2 Links, (B) Demonstration System for Packetized Voice over a Single-User Link with Time-Varying Capacity, (C) Adaptive Variable-Rate Modem with 'No-Cost' Up-Probing, (D) Adaptive Voice Communication on an Integrated, Time-Varying Network. GRA

N78-12272# Lincoln Lab., Mass. Inst. of Tech., Lexington.
THEORY OF THE EFFECTS OF PULSED RFI CODED COMMUNICATION
Steven L. Bernstein 22 Jul. 1977 18 p refs
(Contract F19628-76-C-0002)
(AD-A044070; TN-1977-34; ESD-TR-77-186) Avail: NTIS HC A02/MF A01 CSCL 17/2

This note considers the effects of pulsed RFI (radio frequency interference) on coded communication systems. This problem is of considerable interest in the context of providing reliable satellite communications to military platforms which might suffer degradations due to pulsed RFI sources such as large radars. A general expression relating the computation cut-off rate of a communication channel with RFI to its cut-off rate in the absence of RFI is derived. Several examples are given to show the usefulness of this relationship. Author (GRA)

N78-12273# Lincoln Lab., Mass. Inst. of Tech., Lexington.
AIRBORNE RADARS FOR SURVEILLANCE AND WEAPON DELIVERY
Charles E. Muehe 15 Jul. 1977 44 p refs
(Contract F19628-76-C-0002)
(AD-A044069; TN-1977-23; ESD-TR-77-184) Avail: NTIS HC A03/MF A01 CSCL 17/9

Airborne radars such as AWACS capable of large area surveillance of aircraft over both land and sea have become a reality in the past few years. Soon to follow are radars capable of large area surveillance of moving ground traffic. Through their ability to accurately report enemy movement and to target individual enemy ground vehicles, these radars will undoubtedly have a large impact on intelligence gathering, resource allocation, command, control and the damage assessment functions. This report describes relationships and trade-offs fundamental in the design of airborne surveillance radars in various operational roles. It describes radar capabilities which can be achieved using modern technology including array antennas, advanced waveforms and advanced signal processing techniques. Author (GRA)

N78-12274# Range Commanders Council, White Sands Missile Range, N. Mex. Telecommunications Group.
IRIG STANDARD FOR VHF TIME TRANSMISSION Final Report
Jul. 1977 15 p refs
(AD-A044022; TCG-136-77) Avail: NTIS HC A02/MF A01 CSCL 17/2

The Very High Frequency (VHF) transmission of standard Inter Range Instrumentation Group (IRIG) time code formats utilizing Amplitude Modulation (AM) or Frequency Modulation (FM) techniques is a Department of Defense (DOD) sanctioned scheme for timing distribution. It is the intent of this document to provide guidance and criteria for procurement and evaluation of projected systems which transmit time signals via VHF at various DOD installations. Future equipment procured for the purposes of time distribution of standard time codes A, B, D, E, and H via AM or FM modulation of a 138-144 MHz carrier shall follow these specifications. If replacement of presently installed equipment is required, modernization plans should include procuring of systems which shall comply with this standard. Wherever possible this standard should be adhered to without waivers by all DOD test ranges and facilities. Author (GRA)

N78-12275# Naval Ocean Systems Center, San Diego, Calif.
CAUSES OF VARIANCE IN MAXIMUM ENTROPY SPECTRAL ANALYSIS Final Report, Jan. - Jul. 1976
M. D. Green 1 Jul. 1977 17 p refs
(AD-A044393; NOSC/TR-135) Avail: NTIS HC A02/MF A01 CSCL 09/4

Maximum entropy methods are currently in use for the estimation of spectral quantities. Although several authors have mentioned excessive variance in this type of estimation, no definitive study on the matter has yet been published. This report investigates the variance in the frequency estimate as a function of signal-to-noise ratio, sample offset, initial phase, and the order of the autoregressive process. A discussion of power estimation

is also included. Comparisons with Fourier analysis is included where appropriate. Author (GRA)

N78-12276# Illinois Univ., Urbana-Champaign. Coordinated Science Lab.
ANALYSIS OF INVERTED STRIP DIELECTRIC WAVEGUIDES AND PASSIVE DEVICES FOR MILLIMETER WAVES M.S. Thesis
Ronald Steve Rudokas Jul. 1977 55 p refs
(Contract DAAB07-72-C-0259)
(AD-A044342; R-774; UILU-ENG-77-2221) Avail: NTIS HC A04/MF A01 CSCL 09/1

The analysis of the propagation characteristics of homogeneous and heterogeneous inverted strip dielectric waveguide is presented. Using the heterogeneous guide a ring resonator, distributed directional coupler and beam splitter type directional coupler are described and analyzed. Experimental measurements verifying the analytical results are included. Author (GRA)

N78-12277# Signatron, Inc., Lexington, Mass.
ADAPTIVE ANTENNA CONTROL Interim Technical Report, 25 Jun. - 25 Dec. 1976
Peter Monsen, Steen Parl, and John N. Pierce May 1977 173 p
(Contract DAAB07-76-C-8085; DA Proj. 1X7-63707-D-245)
(AD-A044416; A-212; ECOM-76-8085-1; ITR-1) Avail: NTIS HC A08/MF A01 CSCL 09/1

The Adaptive Antenna Control (AAC) program seeks to improve the performance and availability of DCS troposcatter and diffraction links by means of adapting the antenna response to compensate for variations in the angle of arrival of the received radio signal. Particular emphasis is to be placed on AAC techniques which mitigate aperture-to-medium coupling loss. The program consists of a study phase, the development of AAC equipment, and a test phase. This interim technical report summarizes the program activities during the first 6 months of the 18 month contract effort. The major accomplishments in this initial period were: identification of vertical angle diversity as the most cost and performance effective AAC technique for troposcatter systems; identification of an electronically controlled movable feedhorn system as the most effective method of tracking angle of arrival variations in trans-horizon systems dominated by diffraction propagation; development of a comprehensive troposcatter computer model for prediction of multipath spread, aperture to medium coupling loss, and angle diversity parameters. The report presents the theoretical basis for the troposcatter model and presents results of multipath and aperture to medium coupling loss calculations. GRA

N78-12278# Massachusetts Inst. of Tech., Cambridge. Lab. for Computer Science.
FACILITATING INTERPROCESS COMMUNICATION IN A HETEROGENEOUS NETWORK ENVIRONMENT M.S. Thesis
Paul H. Levine Jul. 1977 110 p refs
(Contract N00014-75-C-0661)
(AD-A043901; MIT-LCS-TR-184) Avail: NTIS HC A06/MF A01 CSCL 09/2

Passing information among processors with different internal data formating schemes has proven to be a major complication to computer networking efforts. Data format translation is necessary to support information exchange in a heterogeneous network environment. Three strategies for performing this translation for communications between a message sender and receiver are: translation by the receiver, translation by an intermediate translator, and the use of a standard intermediate format. The standard format is shown to be the most responsive to a set of general network design principles. The implementation of an intermediate format based interprocess communications scheme requires a mechanism for passing the semantic description of each string of data bits. Two alternative mechanisms for passing this information are discussed, and data tagging is selected as the more flexible. Other implementation considerations are examined, including possible problems in performing translation and the relationship formal translation has to other network message handling functions. Author (GRA)

N78-12279# General Electric Co., Syracuse, N.Y. Electronic Systems Div.
UNATTENDED/MINIMALLY ATTENDED RADAR STUDY. VOLUME 2: 2-D (UNATTENDED) RADAR Final Technical Report, 1 Jul. - 30 Nov. 1976
Thomas B. Shields, comp., S. E. Bell, M. I. Fox, L. D. Hayes, R. V. Jackson, R. D. King, J. W. Krueger, D. J. Murrow, J. A. Rougas, N. A. Schmitz et al Griffiss AFB, N. Y. RADC Aug. 1977 292 p refs 3 Vol.
(Contract F30602-76-C-0380)
(AD-A044274; RADC-TR-77-263-Vol-2) Avail: NTIS HC A13/MF A01 CSCL 17/9

The purpose of the Unattended/Minimally Attended Radar Study was to determine the exploratory and advanced development activities necessary to support the development of Unattended (2-d) and Minimally Attended (3-D) Radars. Volume 2 describes the several radar concepts that were considered for the 2-D unattended role, and the selection of the recommended design. The 2-D Radar provides detection of low-flying aircraft to 60 nmi. The principle design ground rules include extremely high reliability and ease of maintenance, low life cycle cost, and very low prime power. The study concludes the technology is available in 1977 to permit the design and implementation of radars which can operate unattended for periods of up to three months (with 90% confidence of full performance). The recommended design is an L-band cylindrical array, using either an analog or a digital signal processor and a distributed data processor. Prime power usage is from 400 W to slightly more than 1 kW, depending on the implementation scheme selected. Author (GRA)

N78-12280# General Electric Co., Syracuse, N.Y. Electronic Systems Div.
UNATTENDED/MINIMALLY ATTENDED RADAR STUDY. VOLUME 3: 3-D (MINIMALLY ATTENDED) RADAR Final Technical Report, 1 Jul. - 30 Nov. 1976
Thomas B. Shields, comp., S. E. Bell, M. I. Fox, L. D. Hayes, R. D. King, J. W. Krueger, D. J. Murrow, N. A. Schmitz, F. D. Shapiro, J. J. Stewart et al Griffiss AFB, N. Y. RADC Aug. 1977 95 p refs 3 Vol.
(Contract F30602-76-C-0380)
(AD-A044275; RADC-TR-77-263-Vol-3) Avail: NTIS HC A05/MF A01 CSCL 17/9

The purpose of the Unattended/Minimally Attended Radar Study was to determine the exploratory and advanced development activities necessary to support the development of Unattended (2-D) and Minimally Attended (3-D) Radars. Volume 3 describes the radar concepts that were considered for the 3-D Minimally Attended role, and the selection of the recommended design. The 3-D Radar provides accurate range, azimuth, and height data on every target in its surveillance volume, which extends to 150 nmi or 200 nmi (2-radar designs were generated for the two requirements). The principal design ground rules included high reliability and ease of maintenance (to be maintained by a minimum crew), automatic detection, automatic clutter adaptation, automatic performance monitoring/fault location (PM/FL) and use of low-risk technology at a reasonable investment. The recommended system is an L-band, all solid-state phased array, pencil beam radar. The radar can be maintained by a three-man maintenance crew. Radar control, PM/FL, clutter adaptation, and output data interface are all under the control of a (dual) general purpose computer. Author (GRA)

N78-12281# IIT Research Inst., Annapolis, Md.
EMC ANALYSIS OF THE PROPOSED AEROSAT VHF SUBSYSTEM WITH CURRENT INBAND COMMUNICATIONS SYSTEMS. VOLUME 2: WORLDWIDE Final Report
J. G. Preis, Jr. May 1977 74 p refs 2 Vol.
(Contracts F19628-76-C-0017; DOT-FA70WAI-175)
(AD-A043904; ECAC-PR-75-071-Vol-2; FAA-RD-77-56-2)
Avail: NTIS HC A04/MF A01 CSCL 17/2

Information and guidelines are presented pertaining to the electromagnetic compatibility (EMC) of ground and airborne equipments in the Aeronautical Mobile VHF Service with proposed AEROSAT VHF avionics. Volume I provides general guidelines for AEROSAT avionics compatibility with the VHF environment and predicted interactions with aeronautical mobile VHF

equipments in the United States and Canada. Volume II addresses the worldwide VHF environment. The frequency bands considered are 125.4-126.0 MHz and 131.4-132.0 MHz. Author (GRA)

N78-12282# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE MAGNETIC FIELD OF A SINGLE-TURN SOLENOID PLACED COAXIALLY WITH A CYLINDER OR NEAR A PLANE
G. A. Shneyerson 3 Jan. 1977 31 p Transl. into ENGLISH from Izv. Akad. Nauk SSSR Energetika i Transport, Izd vo (USSR), no. 2, 1969 p 85-95
(AD-A044694; FTD-ID(RS)I-1873-76) Avail: NTIS HC A03/MF A01 CSCL 20/3

An approximate calculation is made of the magnetic field (with a sharp surface effect) of a system of massive conductors: a single-turn solenoid-cylinder and a single-turn solenoid-plane separated by a gap. The calculations uses a method based on joining of the solutions obtained for two regions: the slot and the external region. The coordinate of the boundary of the regions is determined from the approximate formulas obtained for the inductance taking into account passage of part of the current outside the region of the gap. GRA

N78-12283# Hughes Aircraft Co., Fullerton, Calif. Ground Systems Group.
INVESTIGATION OF ARRAY TECHNIQUES FOR MULTIPLE BEAMS WITHIN LIMITED SPATIAL SECTORS
R. Tang, F. McNee, D. M. Joe, and N. S. Wong Jun. 1977 134 p refs
(Contract F19628-75-C-0196)
(AD-A044608; Scientific-1) Avail: NTIS HC A07/MF A01 CSCL 09/5

An antenna technique which is capable of providing multiple independent beams over limited scan sections has been developed. This antenna design utilizes overlapping subarrays fed by a stacked-pillbox multiple beam lens. Beams generated by the multiple beam lens can be selected by a beam switching matrix. An antenna design has been worked out to provide 8 or 16 multiple simultaneous beams over an 8 degree half angle cone. The antenna depth is less than the aperture diameter so that it is compact. In this design, sidelobe level of -25 db or lower is achieved with adjacent beams cross over at -2 db. Multiple simultaneous beams with negligible beam coupling loss is accomplished by selecting beams which are more than one beam step apart. Author (GRA)

N78-12284# General Atronics Corp., Philadelphia, Pa.
HIGH POWER CONTROLLER AND ICS Final Report
Samuel J. Harris and Andrew E. Zeger Aug. 1977 91 p refs
(Contract F30602-75-C-0107; AF Proj. 4540)
(AD-A044757; GAC-2800-2970-1; RADC-TE-77-272) Avail: NTIS HC A05/MF A01 CSCL 09/3

High power, all-electronic HF, LF and VLF amplitude and phase controllers are surveyed for use in adaptive Interference Cancellation Systems (ICS). A two-channel HF ICS breadboard is designed and built for use at high power. While the testing is general, one area of particular interest is simultaneous transmission and reception at frequency spacings too close to be realizable with filters. The system aspects of the HFICS are covered in some detail. In view of the limitations of both HFICS and the transceivers with which it may be used, it is concluded that a single channel lower power version of the HFICS should prove of use in airborne applications. Author (GRA)

N78-12285# Syracuse Univ., N. Y. Dept. of Electrical and Computer Science.
A MINIMUM BOUNDARY CONDITION ERROR ALGORITHM FOR THIN WIRE RADIATION AND SCATTERING PROBLEMS Phase Report, 1 Jul. 1975 - 31 Dec. 1976
D. J. Buchanan Griffiss AFB, N. Y. RADC Aug. 1977 51 p refs
(Contract F30602-75-C-0121)
(AD-A044758; RADC-TR-77-278) Avail: NTIS HC A04/MF A01 CSCL 20/3

This report contains results of numerical tests on a method of moments algorithm for the solution of thin wire radiation and scattering problems. The algorithm has convergence behavior similar to a highly overdetermined field point matching scheme. It has been assumed, therefore, that information about the range of applicability of overdetermined wire formulations can be inferred from the results of these tests. Unfortunately, in the tests performed so far, the algorithm has proven to be generally inferior to the other formulations tested. The report is divided into three sections. The algorithm, called MBCRE (for Minimum Boundary Condition Residual Error) is described in Section I. Section II explains the test result tables and also the connection between the MBCRE algorithm and overdetermined point matching schemes. Section III is a listing of the computer program used for the tests. Author (GRA)

N78-12286# Parke Mathematical Labs., Inc., Carlisle, Mass.
SOME EXAMPLES OF THE EFFECTS OF THE POLEWARD F-LAYER TROUGH WALL ON GROUND RANGE AND AZIMUTH DETERMINATION IN AN OTH BACKSCATTER SYSTEM Progress Report, Oct. 1976 - Jan. 1977
Barbara M. Langworthy Hanscom AFB, Mass. AFGL Feb. 1977 52 p
(Contract F19628-76-C-0296)
(AD-A044613; SR-1; AFGL-TR-77-0075) Avail: NTIS HC A04/MF A01 CSCL 04/1

This report describes the effects of a realistic trough wall model on azimuth and range errors expected for a OTH radar system. The strong north-south electron density gradients found in the trough wall result in considerable deviations from great circle propagation. Using a three-dimensional ray tracing program landing points of rays transmitted at 5 MHz were determined as a function of the initial azimuth and elevation angle. Using a spherical model ionosphere as reference, the effects of the realistic trough wall were expressed as range and azimuth errors. To determine the dependence of range and azimuth errors on the variability of the trough wall, upper and lower quartile values of the model were also used in the computations. Power calculations indicate that focusing effects = 15 dB can be expected for selected bundles of rays which just enter the trough wall. Author (GRA)

N78-12287# Computer Corp. of America, Cambridge, Mass.
PACKET SPEECH MEASUREMENT FACILITY Semiannual Technical Report, 11 Dec. 1976 - 30 Jun. 1977
D. A. Low 30 Jul. 1977 72 p
(Contract MDA903-77-C-0156)
(AD-A044469; CCA-77-07; SATR-1) Avail: NTIS HC A04/MF A01 CSCL 17/2

The Packet Speech Measurement Facility (PSMF) is a recording, playback, and measurement facility designed to provide members of the Network Secure Communications (NSC) Project with an investigative tool for packetized speech research. PSMF access will facilitate experiments dealing with the effects of network induced perturbations on real-time communications. This report describes efforts which have culminated in the specification of PSMF design, the development of an access protocol, and the release of a trial facility with operational recording and playback functions. Chapter 2 reviews the PSMF design philosophy and structure detailed in the Preliminary Design Document of February 28, 1977. Chapter 3 elucidates the approaches CCA has taken to implement this structure. Chapter 4 discusses the work scheduled for completion of this initial phase of the PSMF, while chapter 5 provides a summary of PSMF efforts and plans. GRA

N78-12288# Electronics Engineering Group (1842nd), Richards-Gebaur AFB, Mo.
FM QUIETING CURVES AND RELATED TOPICS Final Report
George M. Kizer Aug. 1977 241 p refs
(AD-A044772; Rept-1842-EEG/eetet-TR-77-18) Avail: NTIS HC A11/MF A01 CSCL 17/2

This report describes the relation between readily measured frequency modulation radio transmitter and receiver parameters and the basic baseland signal and noise performance of the radio transmitter/receiver combination. Equations, graphs, and charts are provided to facilitate application. Author (GRA)

N78-12289# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

EFFICIENCY OF MULTISTAGE COMMUNICATION SIGNAL SEARCH WITH CONSIDERATION OF RECEIVER COMPLEXITY

Yu. S. Agafonov 30 Mar. 1977 13 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedeniy, Radiotekhn. (Kiev), v. 15, no. 11, Nov. 1972 p 1386-1388
(AD-A044778; FTD-ID(RS)I-0391-77) Avail: NTIS HC A02/MF A01 CSCL 17/2

The elimination of initial frequency and the time ambiguity in communication systems with pseudorandom discrete phase-manipulated signals required large amounts of time. The signal search time can be reduced by using multistage procedures and multichanneling. Then the number of stages and channels providing the minimum mean signal search time at a fixed complexity and given quality of detection were determined. The plane of ambiguity was broken down into rectangular cells; the sides of the rectangle were equal to the frequency and time search intervals. Author (GRA)

N78-12290# Haskins Labs., New Haven, Conn.
SPEECH RESEARCH Status Report, 1 Apr. - 30 Jun. 1977
Arthur S. Abramson, Thomas Baer, Peter Bailey, Fredericka Bell-Berti, and Gloria J. Borden 30 Jun. 1977 242 p refs
(Contract MDA904-77-C-0157; Grant NSF BNS-76-82023)
(AD-A044820; SR-50-1977) Avail: NTIS HC A11/MF A01 CSCL 17/2

Contents: Manuscripts and Extended Reports--Speech Synthesis as a Tool for the Study of Speech Production; The Study of Articulatory Organization: Some Negative Progress, Phonetic Perception; Cardiac Indices of Infant Speech Perception; Cinefluorographic and Electromyographic Studies of Articulatory Organization, Stimulus Dominance and Ear Dominance in the Perception of Dichotic Voicing Contrasts; Voicing-Conditioned Durational Differences in Vowels and Consonants in the Speech of Three- and Four-Year Old Children; EMG Signal Processing for Speech Research; Perceptual Test of a Phonological Rule; Adaptation of the Category Boundary Between Speech and Nonspeech; Cumulative Index (SR-1 SR-49); Publications and Reports; Appendix: DDC and ERIC numbers (SR-21/22 - SR-48). GRA

N78-12291# Hughes Aircraft Co., Culver City, Calif. Display Systems Lab.
CONTRAST ENHANCEMENT TECHNIQUES STUDY, PHASE 3 Final Report, 1 Feb. 1976 - 4 May 1977
E. W. Opittek Jul. 1977 146 p refs
(Contract N00014-76-C-0563)
(AD-A044735; HAC-P77-210R; HAC-Ref-D7402; ONR-CR-213-124-3F) Avail: NTIS HC A07/MF A01 CSCL 17/2

The development of a real-time TV compatible contrast enhancement unit was conducted. This development was the result of a three phase study program to evolve and evaluate, by computer simulation, alternate contrast enhancement techniques. The three techniques studied were the Local Area Histogram Equalization (LAHE), Local Area Brightness and Gain Control (LABGC), and Haar Transform Filtering (HTF). The three techniques studied were the Local Area Histogram Equalization (LAHE), Local Area Brightness and Gain Control (LABGC), and Haar Transform Filtering (HTF). The LABGC technique was selected for hardware implementation due to its relative simplicity and simulated performance. The LABGC algorithm basically operates on and adjusts the gain and bias of a single pixel element as a function of the statistics of immediate surrounding pixels. If there is a wide variation in the values (high contrast) no gain is applied; conversely, high gain is applied when the immediate area exhibits small variations (low contrast). During the first part of this project, a design study was conducted using the computer simulation model to optimize the mechanization parameters. In particular, the pixel area size of 4 x 4 pixels was selected, the video is digitized to 6 bits and multiple gain transfer functions were selected. An all digital mechanization was selected in order to eliminate analog noise and nonlinearity problems. GRA

N78-12292# Illinois Univ., Urbana-Champaign. Dept. of Computer Science.

APPLICATION OF BURST PROCESSING TO THE SPECTRAL DECOMPOSITION OF SPEECH M.S. Thesis
Jul. 1977 63 p refs
(Contract N00014-75-C-0982)
(AD-A044821; UIUCDCS-R-77-870; UILU-ENG-77-1745) Avail: NTIS HC A04/MF A01 CSCL 17/2

The application of Burst Processing to the problem of spectral decomposition of speech is discussed. It is shown that such a representation provides a viable alternative to conventional speech analyzers. A specific Burst implementation is presented. Author (GRA)

N78-12293# Sperry Rand Research Center, Sudbury, Mass.
IMPULSE RESPONSE TARGET STUDY Final Technical Report, 15 Apr. 1976 - 30 Apr. 1977
C. L. Bennett, R. Hieronymus, and H. Mieras Sep. 1977 130 p refs
(Contract F30602-76-C-0209)
(AD-A044801; RADC-tr-77-273) Avail: NTIS HC A07/MF A01 CSCL 17/9

The space-time integral equation approach is extended to the problem of simple aircraft shapes. The target consisted of a cylindrical fuselage, and rectangular wings, stabilizers, and rudder. Calculations were compared to measurements. The inverse scattering problem was reformulated to take advantage of direct time domain method of solution. Solutions for the sphere, sphere capped cylinder, and flat end cylinder were developed. Author (GRA)

N78-12294# TRW Defense and Space Systems Group, Redondo Beach, Calif.
WIDEBAND DIGITAL TRANSMITTER/RECEIVER Final Report, 15 May 1976 - 25 Mar. 1977
Donald L. Lochhead Aug. 1977 58 p
(Contract F30602-76-C-0278; AF Proj. 6523)
(AD-A044610; RADC-TR-77-261) Avail: NTIS HC A04/MF A01 CSCL 17/2

A laboratory test was conducted to evaluate the bit error rate performance of a 500 Mbps Ka-band demonstration link. Three types of modulation were evaluated; MSK, coherent QPSK, and differentially coherent QPSK. Theoretical calculations which predicted that MSK would be superior to both forms of QPSK were confirmed. Complete performance data including BER, waveform photographs, and spectrum occupancy is presented. Author (GRA)

N78-12295# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
BROADBAND RADIO COMMUNICATION, PART 1
A. M. Semenov and A. A. Sikarev 17 Feb. 1977 287 p Transl. into ENGLISH from the book "Shirokopolosnaya Radiosvyaz" Moscow, Voyenizdat, 1970 p 1-278
(AD-A045075; FTD-ID(RS)T-0122-77-Pt-1) Avail: NTIS MF A01 CSCL 17/2

In the book, written using the open Soviet and foreign materials, are examined the fundamental principles of construction and special feature/peculiarity of broadband communicating systems, are given examples of the realization of such systems, are shown the prospects for their further development and use in radio communication. The book is intended to the cadets of the military schools, students of the military academies and officers of the troops of communication/connection. It can be also used by the wide circle of the readers, who are interested in the problems of the contemporary technique of communication/connection. GRA

N78-12296# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
BROADBAND RADIO COMMUNICATION, PART 2
A. M. Semenov and A. A. Sikarev 17 Feb. 1977 330 p refs Transl. into ENGLISH from the book "Shirokoplosnaya Radiosvyaz" Moscow, Voyenizdat, 1970 p 282-607
(AD-A045076; FTD-ID(RS)T-0122-77-Pt-2) Avail: NTIS MF A01 CSCL 17/2

The examined in the book fundamental special feature/peculiarities and the advantages of broadband radio communication have important practical value, making it possible to actively resist the difficulties, which appear as a result of multiple-pronged propagation, closeness in ether/ester also of the organized

radio jammings. At the same time it will incorrect to assert that the further perfection/improvement and the development of broadband systems are the fundamental and only development trend of radio communication. It is necessary to keep in mind, that even so in principle the use of broadband signals is completely consistent with narrow-band, all the same question of the simultaneous use of those and other systems in one frequency range and especially within the limits of one object of communication/connection (ship, aircraft, etc.) runs into serious difficulties. These difficulties are caused first of all by the interferences, which create broadband systems by the near arranged/located receptor in an entire emission band of broadband transmitter.
GRA

N78-12297# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Tehnology Div.
FUNCTION OF AMBIGUITY OF RANDOM SIGNALS
A. F. Terpugov and V. A. Tolstunov 29 Mar. 1977 20 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Radioelektron. (USSR), v. 15, no. 3, 1972 p 343-349
(AD-A044776; FTD-ID(RS)I-0387-77) Avail: NTIS HC A02/MF A01 CSCL 09/4

A generalization is presented of the concept of the ambiguity function for random signals. The use of the formulas obtained is demonstrated with two specific signals serving as an example. The Woodward ambiguity function, which plays an important role in radar theory, was obtained for the case of determined signals, where interfering noise is white and Gaussian. Wide-band random and pseudorandom signals have recently been used in radar. The possibility of compressing such signals into a very narrow pulse is suggested.
GRA

N78-12298# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
LOGARITHMIC AMPLIFIERS
V. M. Volkov 31 Jan. 1977 499 p refs Transl. into ENGLISH of the book 'Logarifmicheskiye Usiliteli' Kiev, 1962 p 1-244
(AD-A044773; FTD-ID(RS)T-1872-76) Avail: NTIS HC A21/MF A01 CSCL 09/5

This book presents the theory and the calculation of selective and aperiodic logarithmic amplifiers, and examines the possible methods of obtaining logarithmic amplitude characteristic, transient processes in aperiodic and selective logarithmic amplifiers, and their fields of application and use. The book is intended for technical personnel in the field of radio electronics, who are occupied by development and the construction of logarithmic amplifiers, and also for the students of radio engineering.
GRA

N78-12299# Semcor, Inc., Moorestown, N. J.
THE EXTENSION OF GPMS ARCHITECTURE FOR THE DISTRIBUTION OF AUDIO SIGNALS WITHIN NAVY AIRCRAFT
5 May 1975 25 p refs
(Contract N62269-75-C-0326)
(AD-A044739; SEMCOR-SK-JJK-75-125-1) Avail: NTIS HC A02/MF A01 CSCL 09/3

This report presents the results of an engineering study performed to investigate possible ways of extending the basic General Purpose Multiplex System (GPMS) architecture to handle the distribution of audio signals within Navy aircraft. The study is a systems engineering look at the problems of multiplexing the aircraft audio signals and at methods by which this multiplexing can be accomplished. The subjects covered are presented essentially in sequence according to the chronological order in which the study proceeded. The first discussion on the general characteristics of audio signals is followed by a description of the types of audio information found in Navy aircraft. The operational characteristics and requirements of audio distribution systems in typical Navy aircraft are then presented. The aircraft selected for this purpose are the A-7E (Corsair II) and the P-3A(Orion), which represent opposite ends of the spectrum with respect to aircraft size and audio requirements. The A-7E is a single-seat attack aircraft, while the P-3A is a four-engine ASW patrol aircraft with 14 flight crew stations. This report neither recommends nor rejects the implementation of audio multiplexing in Navy aircraft. A decision to multiplex or not to multiplex audio signals must ultimately be supported by analyses of cost-effectiveness, system space and weight considerations, and impact on mission effectiveness. Such analyses were not undertaken in this study.
GRA

N78-12300# Joint Publications Research Service, Arlington, Va.
TRANSLATIONS ON TELECOMMUNICATIONS POLICY, RESEARCH AND DEVELOPMENT, NO. 19
9 Nov. 1977 73 p Transl. into ENGLISH from the world press and radio
(JPRS-70124) Avail: NTIS HC A04/MF A01

Translations are presented from the world press and radio relating to worldwide political, economic and technical developments in telecommunications, computers, and satellite communications. Coverage is worldwide with focus on France, Federal Republic of Germany, United Kingdom, Italy, Japan, the U.S.S.R., People's Republic of China, Sweden, and the Netherlands.
Author

N78-12301# Joint Publications Research Service, Arlington, Va.
TRANSLATIONS ON TELECOMMUNICATIONS POLICY, RESEARCH AND DEVELOPMENT, NO. 20
14 Nov. 1977 58 p Transl. into ENGLISH from the world press and radio
(JPRS-70156) Avail: NTIS HC A04/MF A01
For abstract, see N78-12300.

N78-12302# Joint Publications Research Service, Arlington, Va.
TRANSLATIONS ON TELECOMMUNICATIONS POLICY, RESEARCH AND DEVELOPMENT, NO. 21
21 Nov. 1977 84 p refs Transl. into ENGLISH from the world press and radio
(JPRS-70200) Avail: NTIS HC A05/MF A01
For abstract, see N78-12300.

33 ELECTRONICS AND ELECTRICAL ENGINEERING

Includes test equipment and maintainability; components, e.g., tunnel diodes and transistors; microminiaturization; and integrated circuitry.

For related information see also *60 Computer Operations and Hardware* and *76 Solid-State Physics*.

N78-12303 Missouri Univ., Columbia.
SOME THEORY ON STATISTICAL MODELS FOR TEXTURE AND ITS APPLICATION TO RADIOGRAPHIC IMAGE PROCESSING Ph.D. Thesis
Richard William Conners 1976 441 p
Avail. Univ. Microfilms Order No. 77-15501

Theoretical results concerning approaches to texture discrimination are presented, and the results were used on a radiography image analysis problem. A two dimensional random field model for texture is described and motivation for using this particular model was also discussed. Using the model for texture, four texture analysis algorithms were listed and compared.
Dissert. Abstr.

N78-12304 California Univ., Berkeley.
A CHARGE-TRANSFER MULTIPLYING DIGITAL-TO-ANALOG CONVERTER Ph.D. Thesis
Jose Francisco Albarran-Nunez 1976 156 p
Avail: Univ. Microfilms Order No. 77-15586

Charge manipulation techniques in charge transfer devices are considered. A class of circuits is defined--the charge transfer weighted adder--and the limitations for their practical implementation are surveyed. A new input stage for charge transfer devices is devised, which lends itself to accurate charge weighted addition. Using the new input stage, a four quadrant charge transfer multiplying digital-to-analog converter (a special case of a charge transfer weighter adder) is designed and fabricated using N-channel aluminum gate MOS technology. The integrated circuit shows an accuracy in excess of 7 bits plus sign, total harmonic

distortion 68 db below the fundamental, 70 db dynamic range and 200 KHz bandwidth. Dissert. Abstr.

N78-12305 Tennessee Univ., Knoxville.
THE APPLICATION OF A REJECTION TECHNIQUE FOR SLOW RISETIME SIGNALS TO ARC TIMING WITH A Ge(Li) DETECTOR Ph.D. Thesis
Michael O. Bedwell 1977 198 p
Avail: Univ. Microfilms Order No. 77-16570

The application of a refined constant-fraction discriminator to amplitude and-risetime compensated (ARC) timing with a Ge(Li) detector is reported. Three distinguishing features of this ARC timing discriminator are discussed. First, a lower level leading-edge (LLLE) discriminator is used to arm the constant-fraction zero-crossing detector. The threshold level for the the LLLE discriminator is automatically set at one-half the minimum energy level required to produce an output pulse from the unit. An upper level leading-edge (ULLE) discriminator determines the minimum energy level of interest and arms a coincidence gate for the detection of the delayed logic pulse from the zero-crossing detector. The second distinguishing feature of the instrument is the delay in the path of the timing logic pulse from the crossover detection device. This delay allows approximately 19 nsec. after zero-crossing for the input signal to trigger the ULLE discriminator. The third distinguishing feature of the ARC timing discriminator is the addition of a Slow-Risetime-Reject (SRT) circuit, which can be employed to reject the logic pulses resulting from leading-edge timing. Dissert. Abstr.

N78-12306 Florida Univ., Gainesville.
ESTIMATION OF GLOTTAL VOLUME-VELOCITY BY THE LINEAR PREDICTION INVERSE-FILTER Ph.D. Thesis
Michael George Berouti 1976 237 p
Avail: Univ. Microfilms Order No. 77-17000

This research is a feasibility study of inverse-filtering the acoustic speech wave. The major objective was to obtain, from the speech signal, an accurate estimate of the glottal volume-velocity. To do so, several methods were investigated. The first method was the traditional autocorrelation linear prediction approach. The output of the inverse filter obtained by this method, was an error signal, called the residue, which must be lowpass-filtered in order to obtain the glottal volume-velocity. This method was implemented in a fully automated fashion for the case of sustained isolated vowels. Several preocedures were developed to improve upon the method and build confidence in the results. Preemphasis, peak-picking, and root-extraction are discussed as means of improvement. Also, double linear prediction, a novel method, is introduced as a possible way of improvement. Dissert. Abstr.

N78-12307 California Univ., Berkeley.
HIGH-VOLTAGE CMOS DECODER/DRIVER FOR PLASMA DISPLAYS Ph.D. Thesis
Wing-Yen Chu 1976 111 p
Avail: Univ. Microfilms Order No. 77-15571

A high voltage complementary MOS process which yields N-channel double-diffused MOS transistors and P-channel MOS transistors with drain to source breakdown voltage of 120 volts has been devised. Based on this process, CMOS circuits for both the X and Y axis decoder/drives for the plasma panel are designed. An experimental version of an integrated X decoder/driver with 8 output drive lines was fabricated. Tests on this circuit confirmed the feasibility of the CMOS approach to integrate the plasma panel drive circuitry. Dissert. Abstr.

N78-12308 California Univ., Berkeley.
A NEW APPROACH TO THE INTERCONNECTION PROBLEM OF MULTILAYER PRINTED CIRCUIT BOARD Ph.D. Thesis
Benjamin Shiu-Ming Ting 1976 84 p
Avail: Univ. Microfilms Order No. 77-15883

A new approach is introduced to the interconnection (routing) problem of the multilayer printed circuit (MPC) board. A large number of circuit components are mounted on top of the board. Conductor wires are to be laid on various layers on the board-such that circuits connections can be properly made. Two levels of decision making are involved. First is the question of feasibility. It is possible that some circuit connections can not be made because of space constraints. The second decision problem involves optimization. In the case where all connections can be made on the board, the solution may not be unique. The best space utilization scheme should be selected. The theoretical aspects of the routing problem are explored. Since the number of connections are finite, the routing problem can be formulated into several combinatorial problems. The practical considerations of the routing problem are included as part of the constraints in the theoretical formulation. Dissert. Abstr.

N78-12309 Missouri Univ., Columbia.
STATE VARIABLE MODELING AND ANALYSIS OF A THYRISTOR dc DRIVE ON WEAK POWER SYSTEMS Ph.D. Thesis
Prakash Haribhai Nayak 1976 292 p
Avail: Univ. Microfilms Order No. 77-15539

The phase-controlled thyristor dc drive on weak power systems is modeled in the time domain. A state variable formulation is used for the discrete nonlinear model. This model is used to obtain the steady-state initial values of the state vector and the commutation delay for a given phase control delay and a given constant load torque. Then solving the state equations, the time response in an interval between steady-state successive thyristor gating instants is obtained. The system equations are formulated in a manner which enables one to use a connection matrix to extend algebraically the response of the above interval over an entire cycle. Next, local linearization is performed about an equilibrium state to obtain a small-signal steady-state model. Then a closed-loop current control system stability in the small analysis is presented using the linearized model. Dissert. Abstr.

N78-12310 Marquette Univ., Milwaukee, Wis.
NEGATIVE DIFFERENTIAL RESISTANCE AND SWITCHING IN SEMICONDUCTOR-METAL POWDER AGGREGATES Ph.D. Thesis
William Robert Rueth, Jr. 1976 96 p
Avail: Univ. Microfilms Order No. 77-16767

It was observed that when semiconductor and metal powders were combined, the electrical behavior of the aggregates exhibited reproducible negative differential resistance and switching effects. This electrical behavior was reported in a variety of materials, for example, amorphous semiconductors and thin film oxides. These studies were undertaken to determine the primary conduction mechanism and material parameters which cause the observed electrical behavior. The semiconducting powders were limited to silicon and electrical grade silicon carbide. Reproducible solid samples were made by mixing the powders with an adhesive. The steady state current-voltage characteristics were measured using a direct current, voltage source. This data indicated an ohmic region at low voltages. Dissert. Abstr.

N78-12311 Purdue Univ., Lafayette, Ind.
A SURFACE WAVE INTERACTION CHARGE COUPLED DEVICE Ph.D. Thesis
Stephen Douglas Gaalema 1976 115 p
Avail: Univ. Microfilms Order No. 77-15407

The Surface Wave Interaction Charge Coupled (SWICC) device operates in a manner similar to a conventional CCD except that the potential wells which confine the minority carrier charge packets are formed by the electric field associated with a traveling piezoelectric acoustic surface wave. The power consumption, charge capacity, signal to noise ratio, and transfer efficiency of a SWICC device are calculated or compared to a conventional CCD. The design and construction of a prototype separated media SWICC device consisting of a LiNbO3 substrate in close proximity to a silicon wafer is described. The operation of this device at frequencies up to 35 MHz is reported. The depletion of minority carriers from the surface of the silicon by the traveling wave, the subsequent injection of minority carriers by a light pulse, their collection by a p-n junction, and the effects of surface states on the transfer efficiency are observed and compared with a computer simulation of the device. Dissert. Abstr.

N78-12312 Old Dominion Univ., Norfolk, Va.
PRECISE FREQUENCY CONTROL OF THE VOLTAGE CONTROLLED OSCILLATOR USING FINITE DIGITAL WORD LENGTHS Ph.D. Thesis
Timothy Peter Hulick 1977 153 p
Avail: Univ. Microfilms Order No. 77-16737

A method for interchanging the probability density functions of amplitude and frequency was developed so that the latter becomes known with certainty while the former is known only to the extent that it is within a certain range. The method makes practical the use of the fast tuned voltage controlled oscillator as the local oscillator in a frequency scanning superheterodyne receiver. Exact frequency is expressed by a digital word of finite bit length that, in actuality, expresses the value of a quantized amplitude variable whose quantized value represents a precise frequency. Because of the interrelationship of amplitude, frequency, and time through the Fourier Transform, functions of these variables are also interrelated suggesting the possibility that the original certainty of amplitude information may be traded with the original uncertainty of frequency information.
Dissert. Abstr.

N78-12313 Purdue Univ., Lafayette, Ind.
DYNAMIC STABILITY ASSESSMENT MODELS FOR PARALLEL ac-dc POWER SYSTEMS Ph.D. Thesis
John William Klein 1976 165 p
Avail: Univ. Microfilms Order No. 77-15430

A mathematical model is developed to investigate the dynamic stability dc system in parallel with an ac transmission system. The dynamic stability model for a one machine infinite bus system is developed first. This model is used to determine the dynamic stability of the parallel ac - dc power system under different control configurations. The method is then applied to a two machine infinite bus parallel ac - dc power system. In these studies, the ac power system is represented by either a radial or delta connected configuration. The effect of different control methodologies upon the dynamic stability of these two systems is studied. In all studies performed, favorable comparisons were obtained between the predictions of the dynamic stability model and detailed hybrid computer studies. Further, it is shown that modulations of the dc power can greatly enhance the dynamic stability of the system. However, best results are obtained using power system stabilizers on all machines of the ac system, and modulation of the power in the dc system. Dissert. Abstr.

N78-12314 California Univ., Berkeley.
DC SOLUTIONS AND COMPLETE STABILITY OF NONLINEAR NETWORKS Ph.D. Thesis
Niantsu Nathanuial Wang 1976 151 p
Avail: Univ. Microfilms Order No. 77-15904

Important qualitative problems in nonlinear circuits studied: the dc operating-point analysis and the consideration of complete stability of dynamic nonlinear autonomous networks. In the operating-point analysis, the concept of the degree of a map was employed to develop a simple but unified geometric approach to the analysis of a large class of nonlinear resistive networks. In the consideration of complete stability, the so-called hybrid content and hybrid pseudo-content functions were used as the Liapunov functions to establish complete stability for reciprocal networks. A fairly sharp result was first obtained for complete networks and then generalized it to networks which may not have a complete set of variables. Most theorems are presented in a form which can be readily checked by a CAD program.
Dissert. Abstr.

N78-12315# Aerospace Corp., El Segundo, Calif. Ivan A. Getting Labs.
DEVELOPMENT OF MILLIMETER-WAVE SUPER SCHOTTKY MIXER DIODES Progress Report, 1 Jul. 1975 - 30 Sep. 1976
Malcolm McColl, Michael F. Millea, and Arnold H. Silver 19 Aug. 1977 55 p refs
(Contract F04701-76-C-0077)
(AD-A044276; TR-0077(2777)-1; SAMSO-TR-77-194) Avail: NTIS HC A04/MF A01 CSCL 09/5

The Electronics Research Laboratory of The Aerospace Corporation is developing a heterodyne millimeter wave Superconducting Low Noise Receiver. This report, covering FY 76 and FY76T, discusses the progress in developing techniques to extend the performance of the super-Schottky mixer diode into the millimeter wavelength region. The report is divided into four subjects: (1) the identification of leakage mechanisms and their control; (2) a superconducting Schottky contact to n-type InSb; (3) a superconducting contact to an (InGa)Sb surface on n-InSb, and (4) the contact array diode. Author (GRA)

N78-12316*# National Aeronautics and Space Administration, Washington, D. C.
PLASMON AND EXCITON SUPERCONDUCTIVITY MECHANISMS IN LAYERED STRUCTURES
A. M. Gabovich, E. A. Pashitskiy, and S. K. Uvarova Oct. 1977 18 p refs Transl. into ENGLISH from Fiz. Nizkikh Temperatur (Kiev), v. 1, no. 8, 1975 p 184-995 Transl. by Kanner (Leo) Associates, Redwood City, Calif. Original doc. prep. by Acad. of Sci. USSR, Moscow, preprint no. 4 p 1-25
(Contract NASw-2790)
(NASA-TM-75140; Preprint-4) Avail: NTIS HC A02/MF A01 CSCL 09C

Plasmon and exciton superconductivity mechanisms are discussed. Superconductivity in a three layer metal semiconductor metal and insulator semimetal insulator sandwich structure was described in terms of the temperature dependent Green function of the longitudinal (Coulomb) field. The dependencies of the superconducting transition temperature on structure parameters were obtained. In a semiconducting film, as a result of interactions of degenerate free carriers with excitons, superconductivity exists only in a certain range of parameter values, and the corresponding critical temperature is much lower than in the plasmon mechanism of superconductivity. Author

N78-12317*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
DEVELOPMENT OF A MULTIPLEXED BYPASS CONTROL SYSTEM FOR AEROSPACE BATTERIES
H. A. Frank 1 Nov. 1977 66 p refs
(Contract NAS7-100)
(NASA-CR-155271; JPL-Pub-77-65) Avail: NTIS HC A04/MF A01 CSCL 09C

A breadboard bypass control system was developed to control a battery comprised of 26 JPL-developed negative limited Ni-Cd cells. The system was designed to automatically remove cells from the circuit when their voltages exceeded a fixed limit on charge and fell below a fixed limit on discharge. Major components of the system consisted of a cell voltage monitor, a multiplexing circuit, and individual electromechanical relays for each cell. The system was found to function well in controlling the battery during a simulated 10-month MM-71 mission and a 2-month simulated low earth orbit cycling mission. A flight version of the bypass system was estimated to have a total parts count of 150 and total weight of 1.63 kg. When fully developed, the system shows promise for improving life and reliability of spacecraft batteries. Author

N78-12318# Air Force Weapons Lab., Kirtland AFB, N. Mex.
PORTABLE UNIVERSAL PULSER (PUP) OPERATING MANUAL Final Report
D. C. Koller Aug. 1977 95 p
(AD-A044288; AFWL-TR-77-44) Avail: NTIS HC A05/MF A01 CSCL 14/2

This report represents the results of the complete development of a portable direct drive pulser system. Though fabricated for a specific application (EMP Direct Drive Test of the 1200 kVA Power System for the E-4), the pulser system in a modular configuration allows great flexibility through simple hardware changes. Presently configured for 12 Damped Sine Wave frequencies at a fixed Q of 24, the two output amplifiers can be driven series push-pull for high voltage (=1500 volts) or in parallel for high current (=20 amperes) output. Burst CW and CW at the 12 preselected frequencies are available without additional modification. Presently available are 10 kHz, 20 kHz, 50 kHz, 100 kHz, 800 kHz, 1 MHz, 2 MHz, 4 MHz, 10 MHz, 30 MHz 50 MHz, and 100 MHz. Other waveforms can be amplified for direct drive given an external low level source. Author (GRA)

N78-12319# School of Aerospace Medicine, Brooks AFB, Tex. Aerospace Medical Div.
MIE: A FORTRAN PROGRAM FOR COMPUTING POWER DEPOSITION IN SPHERICAL DIELECTRICS THROUGH APPLICATION OF MIE THEORY Interim Report, Sep. 1976 - Jan. 1977
Earl L. Bell, David K. Cohoon, and John W. Penn Aug. 1977 81 p refs

(AD-A044226; SAM-TR-77-11) Avail: NTIS HC A05/MF A01 CSCL 20/3

A homogeneous, nonmagnetic spherical dielectric is immersed in an electromagnetic field. The program is to determine the absorbed power density at internal points, average absorbed power density, and total absorbed power inside the sphere. A FORTRAN computer program called MIE has been designed to compute the required numerical quantities. This report describes the program in sufficient depth to permit job setups and implementation on any modern computer. Mathematical theory and formulae, structure and sequence of control parameter and data cards, output format, and function subprograms and subroutines are covered in detail. An extensive discussion of the Mie solution, sample problems with associated computer results, and a listing of program MIE are included in appendixes. Author (GRA)

N78-12320# Colorado Univ., Boulder. Electromagnetic Lab.
PROPAGATING MODES ALONG A THIN WIRE LOCATED ABOVE A GROUNDED DIELECTRIC SLAB Interim Technical Report
Edward F. Kuester and David C. Chang Griffiss AFB, N. Y. RADC Jun. 1977 25 p refs
(Contracts F19628-77-C-0093; N00014-76-C-0318)
(AD-A044061; TR-2; RADC-TR-228) Avail: NTIS HC A02/MF A01 CSCL 20/14

The possible propagating modes supported by a wire located parallel to a grounded dielectric slab are investigated. While at low frequencies a quasi-TEM behavior is exhibited, it is shown numerically that under certain conditions, a very different surface-attached character emerges. These results suggest the possibility of similar behavior occurring in the related, but more difficult to analyze configuration of open microstrip lines. The particular structure analyzed here is of interest mainly because of its potential application in air strip ground radar monitoring system, which conceivably can consist of a horizontal wire located above a reinforced concrete slab lying above a conducting earth surface. GRA

N78-12321# Naval Research Lab., Washington, D. C.
RELIABILITY PREDICTION STUDIES ON ELECTRICAL INSULATION: NAVY SUMMARY REPORT Final Report
E. L. Brancato, L. M. Johnson, F. J. Campbell, and H. P. Walker (Naval Ship Eng. Center, Hyattsville, Md.) 13 Jul. 1977 142 p refs
(SF53538707)
(AD-A044156; NRL-8095) Avail: NTIS HC A07/MF A01 CSCL 14/4

Reliability prediction studies on magnet wire, motor insulation systems, and aerospace wires, conducted over a span of 20 years, are summarized. Emphasis is on thermal aging of insulation, including problems in development of evaluation methods and equipment, analysis of data, and development of Navy and industry standards. The usefulness of truncating data to save time is discussed, and truncation is found to save up to 20% in testing time. New and improved equipment is described, including a novel condensation chamber that provides a controlled wet humidity cycle during functional evaluation of insulation systems. A recommendation to adjust the Navy's 40,000-h lifeline benchmark is made, on the basis or recent data and field experience. Regression analysis data for 254 magnet wire twist tests and 62 insulation system motorette tests are documented. Author (GRA)

N78-12322# Aerospace Corp., El Segundo, Calif.
PROCEEDINGS OF THE CONFERENCE ON REWORK AND REPAIR OF PRINTED CIRCUIT BOARDS Final Report
1 Aug. 1977 364 p Conf. Held at El Segundo, Calif., 22-23 Mar. 1977
(Contract F04701-76-C-0077)
(AD-A044219; TR-0077(2902)-1; SAMSO-TR-77-117) Avail: NTIS HC A16/MF A01 CSCL 09/5

On 22 and 23 March 1977, SAMSO and Aerospace sponsored a unique conference on the rework and repair of already assembled printed circuit boards. Although there have been many conferences relating to the design, fabrication, and testing of space and missile systems and components, little attention has been directed towards repair and rework problems. This conference was intended to provide a forum for the exchange of industry and government experiences, problems and solutions in this specialized area. Printed circuit boards are used in space and missile systems to mount and interconnect the thousands of electronic parts in the various electronic components. Although it is everyone's intention to perfectly assemble the parts on each printed circuit board, and to never rework the boards after assembly, cost and schedule considerations require the repair or rework in many situations. Fundamentally, these situations develop as a result of poor workmanship, a part failure, or a design change. Author (GRA)

N78-12323# Naval Surface Weapons Center, White Oak, Md.
COMPUTER AIDED WIRE WRAPPING OF INTEGRATED CIRCUIT BOARDS Final Report
Donald L. Bartusek May 1976 27 p
(AD-A044394; NSWC/WOL/TR-76-37) Avail: NTIS HC A03/MF A01 CSCL 09/2

This report is written as a user's manual for the computer algorithm that automatically produces a deck of cards to submit to an automatic wire wrapping facility. A simplified user language is used for data input which is written in dip coordinates taken directly from the logic drawings. Author (GRA)

N78-12324# Raytheon Co., Waltham, Mass. Research Div.
COST-EFFECTIVE GaAs READ IMPACT TRANSMITTERS Scientific Report, 29 Mar. - 29 Sep. 1976
R. N. Wallace Griffiss AFB, N. Y. RADC May 1977 98 p refs
(Contract F30602-76-F-0143)
(AD-A044034; S-2166; RADC-TR-77-178; SR-1) Avail: NTIS HC A05/MF A01 CSCL 09/5

The objective of this program is to develop a low-cost 5-GHz 40-W FM CW transmitter, using GaAs Read IMPATT diodes as RF power-generating elements, suitable for data-link applications. Results of work so far indicate that the RF performance goals for the transmitter can be achieved, but that size, weight, and primary power consumption goals will be exceeded. We have designed a transmitter system that separates the unit into four main subassemblies: a VCO-driver, a multidiode output stage, a multichannel current regulator, and a dc-to-dc inverter. The VCO-driver, producing 3.3-W output at 5 GHz, has been assembled and tested. Epitaxial wafers for the high-power GaAs Read diodes to be used in the output stage have been successfully grown. The best diode result obtained so far is 21-W CW output at 4.86 GHz with 29.5 percent efficiency, and five of six wafers processed have produced 15-W diodes. The diodes permit a four-diode output stage. Six monthly shipments of six diodes representative of those to be used in the output stage have been made to RADC. The ourput stage design uses a nonresonant parallel-type power combiner based on the modified Wilkinson hybrid described by Gysel. Four single-diode oscillator modules are coupled to this combiner. The combiner and modules are realized in trapped inverted microstrip (TIM) line. Basic TIM-line test circuits have been assembled and are awaiting evaluation. A resonant-cavity power combiner design is also available for possible use as an output stage. The circuit design for the multichannel current regulator is complete. GRA

N78-12325# Westinghouse Research Labs., Pittsburgh, Pa.
THIN FILM TRANSISTOR ADDRESSED DISPLAY Quarterly Report, Sep. - Dec. 1976
Thomas P. Brody, Fang C. Luo, David H. Davies, and Edwin W. Greeneich Aug. 1977 35 p ref
(Contract DAAB07-72-C-0061; DA Proj. 1S7-62705-AH-94D)
(AD-A044077; ECOM-72-0061-11) Avail: NTIS HC A03/MF A01 CSCL 09/5

This is the eleventh quarterly report on Contract DAAB07-72-0061. During this period we have improved the quality level of the 6 in. x 6 in. 30 lpi TFT-EL displays. In addition we have rebuilt the jigs and tooling and fabricated 30 lpi displays using a new format. This format was designed to be compatible with the ECOM-ARTADS Digital Message Device. A few runs with the new tooling resulted in reasonably good quality displays in the new format. Author (GRA)

N78-12326# Princeton Univ., N. J. Dept. of Electrical Engineering.
FREQUENCY AND TEMPERATURE TESTS FOR LATERAL NONUNIFORMITIES IN MIS CAPACITORS

C. C. Chang (Industrial Tech. Res. Inst., Hsinchu, Taiwan) and Walter C. Johnson 15 Mar. 1977 27 p refs Submitted for publication
(Contract DAAG53-76-C-0059; DARPA Order 2182)
(AD-A044064; NVL-0059-004) Avail: NTIS HC A03/MF A01 CSCL 09/1

Two techniques are presented for distinguishing between lateral nonuniformities and interface states in metal-insulator-semiconductor capacitors, one based on the frequency dependence of the response of interface states and the other on the freeze-in of carriers in interface states at liquid nitrogen temperature. Experimental examples are given of the use of both techniques. Author (GRA)

N78-12327# Westinghouse Electric Corp., Horseheads, N. Y. Industry and Government Tube Div.
MANUFACTURING METHODS AND TECHNOLOGY. ENGINEERING FOR TFT ADDRESSED DISPLAY Quarterly Report, 7 Nov. 1976 - 7 Feb. 1977
D. H. Davies, W. L. Rogers, H. Y. Wey, and M. Green 10 May 1977 46 p refs
(Contract DAAB07-76-C-0027)
(AD-A043956; Rept-77-8F9-PRODE-R2; QR-3) Avail: NTIS HC A03/MF A01 CSCL 09/1

This is the Third Quarterly Report on manufacturing methods and technology evaluation for the fabrication of thin film transistor based solid state displays. The automatic pilot manufacturing unit is operating at overall satisfactory levels and producing displays to the required formats etc. The quality level of these displays is as yet not sufficient to pass the required legibility specifications but good progress has been made at identifying the key problem areas. The fabrication equivalent displays at good quality levels on laboratory equipment has continued and confirmation of the major performance attributes was achieved. GRA

N78-12328# Texas Instruments, Inc., Dallas. Central Research Labs.
X-BAND SOLID STATE MODULE Semiannual Technical Report, 30 Sep. 1976 - 31 Mar. 1977
W. R. Wisseman, F. H. Doerbeck, R. E. Lehmann, H. M. Macksey, and V. Sokolov May 1977 70 p refs
(Contract N00173-76-C-0384)
(AD-A043910; TI-08-77-22; SATR-1) Avail: NTIS HC A04/MF A01 CSCL 09/5

This interim report covers the first six months of an eighteen-month program to develop an X-band solid state amplifier. The amplifier is the critical component of an all solid state transceiver module for use in active element, airborne, phased array radars. The performance goals are an output power of 5 W with 25 dB gain over the 9 to 10 GHz frequency band with an efficiency greater than or equal to 20% under pulsed conditions. Two approaches are being pursued to meet these goals: an all GaAs FET amplifier and an FET/Read diode hybrid amplifier. At the completion of the program, two amplifiers of each type will be delivered. The effort during this period was concentrated on GaAs FET development and the development of a three-stage FET driver amplifier. The driver amplifier will be used in both amplifier approaches. A three-stage driver amplifier breadboard has been completed that delivers 1.3 W with 19 dB gain and 20% efficiency over the 9 to 10 GHz frequency range. Author (GRA)

N78-12329# Army Electronics Command, Fort Monmouth, N. J.
SELF-OSCILLATING MIXERS IN DIELECTRIC WAVEGUIDE
Metro M. Chrepta and Harold Jacobs Aug. 1977 31 p refs
(DA Proj. 1T1-61101-A-91A)
(AD-A044128; ECOM-4514) Avail: NTIS HC A03/MF A01 CSCL 09/5

The feasibility of constructing a single integrated functional device in a dielectric waveguide cavity has been demonstrated. This device is a self-oscillating mixer and antenna consisting of a negative resistance diode imbedded in a high-resistivity dielectric such as silicon or Al2O3, with one end of the resonant cavity tapered. This taper serves as an antenna or a coupling element into a standard metal waveguide. Tests have been made at Ku-Band and at V-Band, and it has been found that when used as a receiver, the overall noise figure is in the order of 10 to 12 dB, including the IF amplifiers. These receivers also provide large bandwidths. The device is simple in construction which predicts low cost and ease in manufacturing. Applications are suggested based on noise figures, minimum detectable sensitivities, and RF power capabilities for systems requiring small size and low cost. These include communications, expendable Electronic Warfare (EW) sensors, radar and short-range terminal homing. These devices may lead to future developments in low-cost millimeter-wave integrated circuits in which entire sections of precision machined metal waveguide structures are eliminated. Author (GRA)

N78-12330# IIT Research Inst., Annapolis, Md.
INDEX OF SPECTRUM SIGNATURE DATA
Aug. 1977 20 p Supersedes ECAC-I-IM(SS)
(Contract F19628-76-C-0017)
(AD-A044749; ECAC-I-1N(SS); ECAC-I-IM(SS)) Avail: NTIS HC A02/MF A01 CSCL 09/3

This document is an index of all spectrum signature data collected in accordance with the procedures in MIL-STD-449 and submitted to ECAC. It is published for the purpose of acquainting government agencies and their contractors with the availability of these data. Users desiring any of these documents are requested to requisition them through the Defense Documentation Center (DDC), not from ECAC. For this purpose DDC reference numbers have been included where available. Those spectrum signatures with an L after the DDC number are controlled. Requests for these publications must be sent through the indicated service for approval prior to request from DDC. The DDC Technical Abstract Bulletins (TAB) indicate the appropriate military office to which the request should be addressed. The user is warned that, although MIL-STD-449 was used as a guide in collecting these data, variations in the equipment, specific requirements of the contracting agency and/or ECAC, or technical difficulties encountered in measuring, have made each report unique. Examination of each report is necessary to determine its usefulness for a particular need. This document supersedes ECAC I-1M (SS), Index of Spectrum Signature Data, May 1974. Author (GRA)

N78-12331# IBM Watson Research Center, Yorktown Heights, N.Y.
STUDY OF THE PHYSICS OF INSULATING FILMS AS RELATED TO THE RELIABILITY OF METAL-OXIDE-SEMICONDUCTOR (MOS) DEVICES Semiannual Technical Report, 17 May - 16 Nov. 1976
T. DiStefano, D. R. Young, D. J. Dimaria, J. M. Aitken, and Z. A. Weinberg Jan. 1977 108 p refs
(Contract F19628-76-C-0249; DARPA Order 2180; AF Proj. 2306)
(AD-A044606; Scientific-1; RADC-TR-77-142) Avail: NTIS HC A06/MF A01 CSCL 20/12

The enclosed papers discuss the trapped hole location and annihilation in Si, current and C-V instabilities in SiO2 at high fields, annealing of neutral electron traps in irradiated oxides, Al implanted into the SiO2 layer of MOS structures, electron trapping as a result of Al implantation, the initial oxidation regime of silicon oxidation and the electronic structure of SiO2, SixGe1-xO2, GeO2. Author (GRA)

N78-12332# Cornell Univ., Ithaca, N. Y. Materials Science Center.
FUNDAMENTAL FLUXOID-DEFECT INTERACTIONS IN IRRADIATED SUPERCONDUCTORS Interim Report
Edward J. Kramer Jun. 1977 67 p refs Presented at the Intern. Discussion Meeting on Radiation Effects on Superconductivity, 13-16 Jun. 1977 Submitted for publication
(Contract AF-AFOSR-1189-77; AF Proj. 2306)
(AD-A044734; MSC-2857; AFOSR-77-1189TR) Avail: NTIS HC A04/MF A01 CSCL 20/3

Flux pinning experiments in irradiated superconductors which make it possible to independently vary the defect density p and elementary interaction force f sub p between the defect and the fluxoid lattice are reviewed. A new measure of flux pinning, q, the volume pinning force per defect, is introduced and is shown to be independent of p for p less than 10 to the 22nd

power/cu m. In Nb of B = .5 bc sub 2 and 4.2K, q = 5 x 10 to the minus 18 power n for Frenkel defects, 3 x 10 to the minus 16 power N for cascades, 2 x 10 to the minus 15 power N for 100A dislocation loops and 3 x 10 to the minus 14 power N for 100A voids. The Q's for voids and loops increase strongly with void or loop diameter. Accurate estimates of f sub p for voids and dislocation loops are made and plotted versus Q. The results for the two defects overlap forming a single master curve that can be used as an experimental solution to the summation problem. Reasons why current summation models do not reproduce the master curve are discussed. Author

N78-12333# Illinois Univ., Urbana-Champaign. Dept. of Chemistry.
THEORIES OF ELECTRODE KINETICS
R. A. Marcus Sep. 1977 14 p refs
(Contract N00014-75-C-0942)
(AD-A044680; TR-7) Avail: NTIS HC A02/MF A01 CSCL 07/4

The present lecture consists of two parts. In the first, a comparison is made of theory and experiment for simple electron transfer reactions in solution and at electrodes, reactions for which no bonds are broken or formed. The main part of the lecture is concerned with electrode reactions involving the breaking and forming of chemical bonds and principally with the hydronium ion discharge reaction, H3O(+) + M(e) yields H2O + H-M(ads.). The treatment of this reaction has been the subject of some controversy (cf. 1965 Faraday Discussions on Proton Transfer and more recent literature). To provide further insight, a more dynamical theory of this elementary step for general potential energy surfaces is described. It is then shown how, depending on the nature of the potential energy surface, the theory leads to various approaches in the literature. For example, depending on the surface, the system may or may not for dynamical reasons be able to reach sufficiently easily the saddle-point region or, again, Franck-Condon solvation effects may or may not contribute to the rate. There is a clear need for the application of recent theorectical methods of electronic structure to determine the essential features of the potential energy surface. GRA

N78-12334# Gulf General Atomic, San Diego, Calif.
STUDY OF EFFECTS OF IONIZING RADIATION IN CAPACITORS Final Report
T. M. Flanagan and J. W. Harrity 20 Apr. 1970 34 p refs
(Contract DASA01-69-C-0114)
(AD-A044789; GULF-GA-10002) Avail: NTIS HC A03/MF A01 CSCL 18/8

The results are presented in Tables in Appendix A. The data are tabulated by dielectric type. Beside the name of each material type is listed the number of capacitors of each capacitance value tested and the working voltage of each. As there were no capacitance-value-correlated trends in the data, the listings include data from all units, and the values given are usually averages over many test exposures. The dose is listed in rads (Si) for convenience. Since for high-energy electron energy deposition the energy deposited scales very nearly as Z/A, the doses can be considered as rads (dielectric material). The radiation pulse width and the decay constants (tau) are given in microseconds. The Q sub p and delta-Q values are in units of coulombs per farad-volt-rad, and the Q sub o values are in units of coulombs per farad-volt-rad-microsec. Where a definite voltage dependence of the specific charge release was observed, it is noted at the bottom of the listing. Lack of Q sub o and tau data for time intervals in which a delta-Q is listed implies that a linear interpolation may be used for obtaining intermediate points.GRA

N78-12335# Army Test and Evaluation Command, Aberdeen Proving Ground, Md.
ELECTRICAL SYSTEMS (VEHICLES AND WEAPON SUBSYSTEMS) Final Report
20 Jun. 1977 15 p refs Supersedes MTP-2-2-601
(AD-A045343; TOP-2-2-601; MTP-2-2-601) Avail: NTIS HC A02/MF A01 CSCL 13/6

Provides procedures for evaluating vehicle electrical system performance including power supply for weapon and other subsystems. Discusses power load planning, test temperatures, initial inspections, instrumentation. Describes tests at rated and 75% rated voltage for engine starting power, individual/cumulative internal component requirements. Other tests cover generator/alternator performance, electromagnetic interference, high/low temperature effects, water/humidity effects, reliability, and weapon subsystem demands. GRA

N78-12336# Purdue Univ., Lafayette, Ind. Turner Lab. for Electroceramics.
THE EFFECTS OF SUBSTRATE COMPOSITION ON THICK FILM CIRCUIT RELIABILITY Quarterly Report, 1 May - 31 Jul. 1977
R. W. Vest 31 Aug. 1977 21 p refs
(Contract N00019-77-C-0327)
(AD-A045085; QR-2) Avail: NTIS HC A02/MF A01 CSCL 20/2

The initial stage sintering kinetics for lead borosilicate glasses were studied in order to determine the effects of composition on the surface tension to viscosity ratio. Impurities in the raw materials were shown to have no effect on this ratio, but changes of a few percent in the major constituents resulted in significant changes in both the magnitude and the temperature dependence of this ratio. Thick film resistors were fabricated with and without substrate dissolved in the resistor glass, and significant differences were found in both the magnitude and the temperature dependence of the sheet resistance. Author (GRA)

N78-12337# Rensselaer Polytechnic Inst., Troy, N. Y.
NONDESTRUCTIVE EVALUATION OF ELECTRICAL PROPERTIES OF SEMICONDUCTORS USING SAW
H. Gilboa and P. Das 2 Jul. 1977 205 p refs
(Contract N00014-75-C-0772; Grant NSF ENG-074-22688; NR Proj. 009-017)
(AD-A045324; RPI-MA-ONR-15) Avail: NTIS HC A10/MF A01 CSCL 20/12

This work presents a study of the electrical properties of semiconductors using the interaction between surface acoustic waves and a semiconductor in the separated medium configuration (the SAW convolver). This study has been conducted towards developing a new technique for nondestructive evaluation of semiconductor surfaces using surface acoustic waves. The semiconductor is placed a small distance above the delay line, with a uniform airgap between the two media. Although there is no mechanical contact between the two media, the electric fields associated with the surface acoustic waves penetrate into the semiconductor and interact with the free carriers. As a result of this nonlinear interaction, the SAW is attenuated, there is a change in the SAW velocity, and dc acousto-electric voltages are developed across the semiconductor. In the case of two oppositely propagating surface waves, voltage proportional to the convolution of the two input voltages is also generated. GRA

N78-12338# General Dynamics/Pomona, Calif.
PRODUCTION PROCESS DEVELOPMENT FOR FLEXIBLE PRINTED CIRCUITRY Final Report
Stephen A. Hays, A. Smith Walter, and F. K. Sawyer Sep. 1977 263 p refs
(Contract N00123-76-C-0138)
(AD-A045354; M-24-S-476) Avail: NTIS HC A12/MF A01 CSCL 11/9

The results of a successfully concluded NAV-SEA sponsored program performed by General Dynamics, Pomona, in testing, process development, and fabrication of multilayer Flexible Printed Wiring (FPW) using acrylic adhesive are reported. These acrylic adhesives were obtained in various forms, as copper and/or polyimide laminates and cast film. Based on the findings of this investigation, change-over to these acrylic-polyimide materials is recommended for all continuing FPW fabrication programs, in order to improve yields, improve product reliability, and reduce both processing and overall costs. The program objective of choosing a material/process system which provides a significant reduction in fabrication cost, with an improvement in quality of the product as its acceptance criteria was achieved. This program included testing and fabrication of materials, two layer test pattern FPW, four layer test pattern FPW and a four layer pilot lot FPW consisting of multiple test patterns including an actual tactical missile FPW prototype part. GRA

N78-12339# Stanford Univ., Calif. High Energy Physics Lab.
DEVELOPMENT OF SUPERCONDUCTING-CAVITY STABILIZED OSCILLATORS FROM 1971-1977 Final Report, Apr. 1971 - Mar. 1977
Aug. 1977 11 p refs
(Contract N00014-76-C-0382)
(AD-A044468) Avail: NTIS HC A02/MF A01 CSCL 09/5

Superconducting cavities had been investigated as frequency determining elements of oscillators prior to when our work began at Stanford in 1971. Most of that work had been done at the Institute of Fundamental Electronics at the University of Paris at Orsay under the direction of Professor Septier. Although they successfully tested a number of oscillator techniques using a superconducting cavity as the frequency reference, the stability of these oscillators were limited to about 10 to the 11th power(delta f/f) for short term frequency fluctuations. At Stanford, we estimated that a very high frequency stability of 10 to the-16th power(delta f/f) should be possible using superconducting niobium cavities with an unloaded Q of 10 to the 11th power along with available experimental techniques. Unloaded Q's of 10 to the 11th power had already been demonstrated at Stanford for superconducting niobium cavities. To achieve an oscillator utilizing a superconducting cavity, we designed a circuit which stabilizes a Gunn oscillator at X-band to a superconducting cavity at 8.6 GHz. We called this oscillator system a superconducting-cavity stabilized oscillator (SCSO). Our first test showed that this circuit worked satisfactorily and a short-term frequency stability of 10 to the -12th power(delta f/f) was achieved. The development work on the SCSO proceeded in a number of steps after the SCSO circuit was shown to work satisfactorily. GRA

N78-12340# Northrop Corp., Hawthorne, Calif. Electronics Div.
DESIGN GUIDELINES FOR HYBRID MICROCIRCUITS. VOLUME 1: BEAM LEAD STUDY Final Report, 3 May 1976 - 30 Apr. 1977
J. F. Linder May 1977 73 p
(Contract DAAB07-76-C-1358; DA Proj. 1L7-62705-AH-94)
(AD-A044540; ECOM-76-1358-F-Vol-1) Avail: NTIS HC A04/MF A01 CSCL 09/5

This report is a study of the bonding of beam-leaded chips onto several types of hybrid substrates, mostly with thick film metallization. Beam lead semiconductors of various sizes were bonded on monolayer substrates as well as multilayer substrates of increasing complexity. The integrity of the bonding on the various types of substrates changes permits the author to draw design rules for hybrid circuits comprising beam-leaded chips. This report describes a non-destructive method to test the bonds of beam-leaded chips. Author (GRA)

N78-12341# Northrop Corp., Hawthorne, Calif. Electronics Div.
DESIGN GUIDELINES FOR HYBRID MICROCIRCUITS. VOLUME 2: ENGINEERING GUIDELINES Final Report, 3 May 1976 - 30 Apr. 1977
T. J. Aubry May 1977 408 p
(Contract DAAB07-76-C-1358; DA Proj. 1L7-62705-AH-94)
(AD-A044541; ECOM-76-1358-F-Vol-2) Avail: NTIS HC A18/MF A01 CSCL 09/5

Report delineates design guidelines for thin and thick film hybrids of single and multilayer configurations. The text emphasizes the layout design requirements but includes general information pertaining to manufacturing processes and material properties. Author (GRA)

N78-12342# Naval Weapons Support Center, Crane, Ind. Weapons Quality Engineering Center.
ENGINEERING EVALUATION TESTS OF 20-AMPERE AIRBORNE BATTERY CHARGER (BREADBOARD) MANUFACTURED BY SUNDSTRAND CORPORATION
K. L. Senderak 6 Jul. 1977 40 p
(AD-A045011; WQEC/C-77-297) Avail: NTIS HC A03/MF A01 CSCL 10/2

A proposed military specification for aircraft Ni-Cd battery chargers is presented. Cyclic testing, was performed on a Vapor airborne battery charger manufactured for DC-9 aircraft, P/N 26340061-04 loaned to the Navy for evaluation. The results of this evaluation are reported herein. Following the evaluation of the Vapor charger, a contract was awarded to Vapor Corporation to build one breadboard and three militarized 20-ampere airborne battery chargers. Investigation of nickel-cadmium battery charge techniques with the use of the breadboard charger was conducted. The purpose of this investigation was to define a suitable charge technique for incorporation in three airborne battery chargers to be built to requirements and delivered under contract. The results of this investigation are reported herein. Based upon the results of this evaluation, and other tests which were conducted during the preparation of reference (a), the chargers to be manufactured by Sundstrand Corporation shall: (1) Conform to MIL-C-85050 airborne charger specification. (2) Charge the battery at 1.0A until the battery reaches 16 + or - 1.0V. (3) Pulse charge the battery (main mode) at an average current of 24 A within the average output power envelope shown in Figure 1, consisting of positive and negative pulses. (4) Pulse charge the battery (topping mode) at a constant average current of 5 A consisting of a positive and a negative pulse. The positive pulse shall have a duty cycle of 20% and an amplitude necessary to achieve 5 A average, but not to exceed 35 A. GRA

N78-12343# Naval Avionics Facility, Indianapolis, Ind.
FLUID RESISTANCE TESTING OF ELECTRICAL WIRE USED IN AIRCRAFT AND MISSILES, PART 3
Willard D. Watkins 13 Sep. 1977 25 p
(AD-A045323; NAFI-TR-2201) Avail: NTIS HC A02/MF A01 CSCL 09/1

Several types of insulated electrical wire purchased to MIL-W-22759, MIL-W-81044, and MIL-W-81381, along with a new fluoropolymer insulated wire, were immersed in solvents purchased to MIL-C-43616 and TT-R-248. The ability of the insulation to withstand degradation by the solvents was determined by subjecting the conditioned wire to a dielectric withstand voltage test. This testing differs from previous testing in that the fluids were maintained at 75 C during immersion of the wire specimens. Author (GRA)

N78-12344# Rockwell International Corp., Anaheim, Calif. Electronics Research Center.
THE 16 INPUT/1 OUTPUT SWITCHING MATRICES Final Report, 1 Apr. 1975 - 30 Sep. 1976
P. J. Hagon and D. Penunuri Apr. 1977 67 p
(Contract F19628-75-C-0175)
(AD-A044677; C75-518.1/501; RADC-TR-77-161) Avail: NTIS HC A04/MF A01 CSCL 09/5

The design, fabrication and performance of a 16 input/1 output UHF switch matrix is described in this report. Each switch consists of silicon-on-sapphire PIN diodes, operates in the frequency range 950-1220 MHz, provides 60 db on-off ratio, and reduces the dc power consumed relative to a previous device (Report AFGL-TR-76-0016) by using miniature integrated inductors. Author (GRA)

N78-12345# Florida Univ., Gainesville. Electron Device Res. Center.
COMPUTER AIDED ENGINEERING OF SEMI-CONDUCTOR INTEGRATED CIRCUITS Final Report, 1 Jan. 1976 - 31 Aug. 1977
David P. Kennedy 31 Aug. 1977 391 p refs
(Contract DAAB07-75-C-1344; DA Proj. 1T1-61101-A-00A)
(AD-A044851; ECOM-75-1344-F) Avail: NTIS HC A17/MF A01 CSCL 09/2

The objectives of this program are to remove the empiricism associated with the design and manufacturing of custom integrated circuits for military applications and to reduce the cost of these circuits by devising improved computer-aided engineering techniques. Efforts of research covered by this report are Part I, Semiconductor Device Modeling conducted by the University of Florida and, Part II, Integrated Circuit Process Modeling conducted by Stanford University. Part I of the report deals with: (a) A One-Dimensional Mathematical Model of MOSFET Operation; (b) The Inversion Layer Carrier Mobility in an MOSFET; (c) An Integral Equation-Relaxation Procedure for the Determination of Equilibrium Potentials in Semiconductor Devices; (d) A Test Pattern Model using Monte Carlo Methods of Analysis; (e) Equivalent Circuit Studies; and (f) A Two-Dimensional Model for MOSFET Operation. Part II deals with: (a) Effects of Implantation Damage

on Impurity Profiles in Annealed Si and Calculation of Range Profiles and Recoil Implantation in Multi-Layered Media; (b) Thermal Oxidation (a joint effort by Stanford University Integrated Circuits Laboratory, and Fairchild Camera and Instrument Corp. Research and Development Laboratory); (c) Silicon Epitaxy; and (d) A Mathematical Model of Impurity Diffusion (conducted by Louisiana State University). Author (GRA)

N78-12346# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INVESTIGATIONS OF RADIOELECTRIC DISTURBANCES PRODUCED BY THYRISTOR CONTROL-AND-REGULATION OF VOLTAGE SYSTEMS ON SEA-GOING SHIPS

S. Wankowicz 7 Mar. 1977 13 p refs Transl. into ENGLISH from Budownictwo Okretowe (Poland), no. 2, 1976 p 51-53 (AD-A044781; FTD-ID(RS)I-1726-76) Avail: NTIS HC A02/MF A01 CSCL 09/3

In the planning of a ship it is necessary to provide security for the electric network against radioelectric disturbances noise and especially of a ship with a combustion-prime prime mover supplied with thyristor subsystems for regulation and control. The simplest and most economical currently is the securing of the feed cables that feed the radio cabin the navigation one, the hydroacoustic one and the computing center with anti-noise filters of an attenuation of 100 db, installed on the outside wall of the cabin in the place of input of the cable into the cabin. On research ships it is necessary to use individual separated galvanized electrical circuits networks that supply the electronic radio, navigational, hydroacoustic, and calculating system, in order to insure them against disturbances proceeding from thyristor subsystems for regulation and control. GRA

N78-12347# Lincoln Lab., Mass. Inst. of Tech., Lexington.

SOLID STATE RESEARCH, 1977:2 Quarterly Technical Summary Report, 1 Feb. - 30 Apr. 1977

A. L. McWhorter 15 May 1977 74 p refs (Contract F19628-76-C-0002; AF Proj. 649L) (AD-A044795; ESD-TR-77-110) Avail: NTIS HC A04/MF A01 CSCL 09/3

This report covers in detail the solid state research work of the Solid State Division at Lincoln Laboratory for the period 1 February through 30 April 1977. The topics covered are Solid State Device Research, Quantum Electronics, Materials Research, Microelectronics, and Surface-Wave Technology. Funding is primarily provided by the Air Force, with additional support provided by the Army, ARPA, NSF, and ERDA. Author (GRA)

N78-12348# Harvard Univ., Cambridge, Mass.

THE BEVERAGE WAVE ANTENNA: CURRENTS, CHARGES AND ADMITTANCES. VOLUME 2: EXPERIMENTAL MEASUREMENTS

Robert M. Sorbello Griffiss AFB, N. Y. RADC Feb. 1977 250 p refs (Contracts F19628-76; N00014-75-C-0648) (AD-A044651; SR-1-Vol-2; RADC-TR-77-82-Vol-2) Avail: NTIS HC A11/MF A01 CSCL 09/5

This report presents the results of an experimental and theoretical investigation of the circuit properties of horizontal-wire antennas placed over an imperfectly conducting half-space. Particular emphasis is given to the Beverage wave antenna, a special type of horizontal-wire antenna placed in close proximity to the earth. Earlier work has generally assumed a free-space wave number on the wire, thus neglecting the effect of the half-space. The present study has carefully investigated experimentally the effect of the half-space on the properties of the antenna (current, charge and input admittance) and has included this effect in all theories discussed. The theoretical analysis, appearing in Part I of Vol. I, involves several aspects. The theory of King, Shen and Wu for horizontal wires over an imperfectly conducting half-space was verified experimentally. Discrepancies observed in certain cases were attributed to end effects, not accounted for in the theory. Two semi-empirical theories were subsequently developed which included contributions due to end effects. Both provided good agreement with the measured data. The theory of King was extended to include the Beverage wave antenna and comparisons with measured results proved quite acceptable. GRA

N78-12349# RCA Labs., Princeton, N. J.

SEMICONDUCTOR MEASUREMENT TECHNOLOGY: SUPPRESSION OF PREMATURE DIELECTRIC BREAKDOWN FOR HIGH-VOLTAGE CAPACITANCE MEASUREMENTS Interim Report

Alvin M. Goodman Jul. 1977 28 p refs (Contract NBS-5-35912; ARPA Order 2397) (PB-270288/4; NBS-SP-400-37; LC-77-608129) Avail: NTIS HC A03/MF A01 CSCL 20L

Premature dielectric breakdown encountered in extended-range MIS C(V) measurements are applied-bias voltages above some sample-dependent threshold value is suppressed by eliminating the air space adjacent to the sample surface at the junction of the dielectric and the electrode edge. A simple, easy-to-use apparatus (sample holder and probe assembly) which allows this to be done conveniently and quickly by using a silicone rubber washer to cover the edge of the electrode and the adjacent area is described. Construction details of the apparatus and a test chamber which were tested to 30 kV are provided. GRA

34 FLUID MECHANICS AND HEAT TRANSFER

Includes boundary layers; hydrodynamics; fluidics; mass transfer; and ablation cooling.

For related information see also *02 Aerodynamics* and *77 Thermodynamics and Statistical Physics*.

N78-12350 California Univ., Berkeley.

TRANSITION TO TURBULENCE IN FINITE-DIMENSIONAL APPROXIMATIONS TO THE BOUSSINESQ EQUATIONS Ph.D. Thesis

James Howard Curry 1976 87 p Avail: Univ. Microfilms Order No. 77-15649

Finite dimensional truncations were developed for the Boussinesq equations which govern the convective motion in a fluid layer heated from below. For a particular class of solutions to the truncate equations it was proven that the state of no convection is globally stable for all values of the Rayleigh number less than the critical Rayleigh number. A large class of truncations with bounded solutions was exhibited. Numerical techniques were used to study a particular nonlinear 14 component model for values of the Rayleigh number which exceed the critical value. By following the stationary solutions as a function of increasing Rayleigh number, that value of the Rayleigh number for which the stationary solutions become unstable was identified. When the solutions become unstable, there immediately follows a region of periodic motion, beyond which transition to turbulence occurs. Dissert. Abstr.

N78-12351 Rockefeller Univ., New York.

VELOCITY CORRELATIONS IN MODERATELY DENSE GASES Ph.D. Thesis

David Leon Lieberworth 1976 114 p Avail: Univ. Microfilms Order No. 77-17285

The velocity autocorrelation function is derived that is valid for finite-ranged, repulsive interparticle potentials. For low densities it is found that this function reduces to a sum of two terms, which are evaluated by introducing Krook models that contain two undetermined constants. The first term decays exponentially for time t greater than about 2t sub 0, where t sub 0 is the mean free time. The second term can be analyzed for sub 0 long times using hydrodynamic mode analysis. Dissert. Abstr.

N78-12352 California Univ., Berkeley.

THE CONFORMAL BOOTSTRAP FOR BOSE CONDENSATION OF AN INTERACTING FLUID Ph.D. Thesis

Frank Wilson Adams, Jr. 1976 198 p Avail: Univ. Microfilms Order No. 77-15581

Using field theoretic techniques, Bose fluid with two-body interaction in less than four dimensions was studied. Assuming the existence of a lambda-line along which Bose condensation occurs, a diagrammatic argument to establish the equivalence was given, near this phase transition, of the renormalized

perturbation theory for this model to that for the O(n)-symmetric continuous spin (or n-vector) model with n = 2. This assures the applicability to the Bose fluid of n-vector model results, specifically eta-expansion calculations. Sufficient conditions are found to obtain a dilatation-and conformal-invariant set of integral equations, called the conformal bootstrap for its homogeneous form, from a set of exact integral equations for the interaction Bose fluid. The procedure is to take an infinite-renormalization limit exactly on the phase-transition line. Dissert. Abstr.

N78-12353 Purdue Univ., Lafayette, Ind.
CO-CURRENT, STRATIFIED CHANNEL FLOW: MACROSCOPIC AND MICROSCOPIC PHENOMENA Ph.D. Thesis
Dennis Michael Johns 1976 537 p
Avail: Univ. Microfilms Order No. 77-15423

Cocurrent, airwater, stratified channel flows were investigated in a facility possessing two dimensional characteristics. Pressure drop and boundary layer friction factor data are presented. Bulk phase mean velocity, turbulence intensity, and gas phase turbulence shear stress profiles were studied. Length and velocity scales were determined in the wavy liquid region by conditional sampling techniques. Dissert. Abstr.

N78-12354 Kentucky Univ., Lexington.
MASS TRANSFER DURING DROP FORMATION UNDER JETTING CONDITIONS Ph.D. Thesis
Yung-fu Huang 1976 217 p
Avail: Univ. Microfilms Order No. 77-15950

An experimental study was made of the disperse phase controlled mass transfer during drop formation under jetting conditions. Liquid-liquid extraction in a perforated plate column was studied. The experimental technique of Skelland and Minhas was used but with a single nozzle. Three high interfacial tension systems and one low interfacial tension system were employed. The selection of these systems gave all possible forms of free fall drop behavior, namely internally stagnant, circulating, and oscillating. Photographs were taken during the 249 experimental runs to obtain information on the jet length, free-fall height, number of free-fall drops, and the location of coalescence. For measurements of jet contraction and drop size from jet breakup, another 105 runs were made in an aquarium to avoid optical distortion. Correlations obtained from these measurements were used to predict the jet contraction and drop size in the extraction column. Dissert. Abstr.

N78-12355 Florida Univ., Gainesville.
A COMPUTERIZED METHOD OF EVALUATING TRACE PARTICLE RECORDS OF TURBULENT FLOW FIELDS Ph.D. Thesis
Gary Ralph Jackman 1976 158 p
Avail: Univ. Microfilms Order No. 77-17026

A prism was used to view particles tracing the motion of fluid in a pipe. The particles viewed in the prism were recorded with a cinematographic camera. The prism produced two images for each particle, and this geometric relationship determined the true particle position from the two image positions. Computerized evaluation techniques were developed to digitize the cinematographic records of the flow entrained trace particles. The digitized data were processed through computer programs developed to follow the recorded particle images as they traverse the prism faces and pair the image paths that correspond to particles traversing the studied flow volume. These data were further processed to yield three dimensional positions and velocities. Computer graphic methods were developed and used to display the instantaneous flow in two or three dimensional views. Dissert. Abstr.

N78-12356 Vanderbilt Univ., Nashville, Tenn.
THE EFFECT OF MASS TRANSFER ON HEAT TRANSFER RATES FOR TWO-PHASE FLOW IN A VERTICAL PIPE Ph.D. Thesis
Subba-Rao Ravipudi 1976 179 p
Avail: Univ. Microfilms Order No. 77-16081

The effect of gas-liquid froth composition, gas-liquid properties, and mass transfer on heat transfer rates and coefficients in a shell and tube steam condenser was studied. Correlations based on dimensional analysis are proposed for two-phase heat transfer without mass transfer, two phase heat transfer with mass transfer, and mass transfer coefficients at high vapor pressures. An economic analysis showed that a two phase cooling system costs 50% less than a conventional cooling system with a cooling tower. Dissert. Abstr.

N78-12357 Ohio State Univ., Columbus.
CROSS CORRELATION TECHNIQUE FOR THE MEASUREMENT OF PARTICLE VELOCITIES AND STEREOSCOPIC FLOW VISUALIZATION Ph.D. Thesis
Gary Benjamin Tatterson 1977 228 p
Avail: Univ. Microfilms Order No. 77-17144

Point velocity measurements of particle motions in a stirred tank were successfully made by tracking and correlating particle shadow signals produced by crossed laser beams. Data were taken to prove the validity of the technique and to demonstrate its usefulness for fluid and particle velocity measurements. Flows at four positions (three in a tank stirred by a pitched six blade turbine, the fourth in a tank stirred by a Rushton impeller) were studied. The positions were chosen to provide information about the nature of the jet flow at the exit of the pitched blade turbine, in a vertical wall flow, in an intermittent region, and in the jet of the Rushton impeller. Velocity vector diagrams of the flows were made to demonstrate the variety of flow patterns existing at various locations in a stirred tank. In addition to these diagrams, total mass flow, total momentum flow, total energy flow, event activity, and the mass average velocity are shown as functions of direction. Dissert. Abstr.

N78-12358 Purdue Univ., Lafayette, Ind.
GENERATION OF SURFACE AND INTERNAL WAVES IN A VISCOUS ELECTRICALLY CONDUCTING DENSITY STRATIFIED FLUID BY SURFACE PRESSURE FLUCTUATIONS Ph.D. Thesis
Peter J. Staiger 1976 136 p
Avail: Univ. Microfilms Order No. 77-15477

The generation of motion in a horizontal layer of a viscous, electrically conducting, density stratified fluid by pressure fluctuations in an inviscid, nonconducting fluid above its surface is considered. These pressure fluctuations may be used to represent a turbulent wind or a slowly moving atmospheric pressure distribution. After the equations of motion and boundary conditions are formulated, they are linearized and transformed to Fourier and Laplace space. The transformed problem is then solved for the displacement field in a number of special cases where viscosity, the magnetic field, and density stratification are considered separately. For the case of density stratification, the growth of internal wave spectra is investigated. It is found that for moving atmospheric pressure distributions that a resonance condition leads to growth of internal waves. Dissert. Abstr.

N78-12359 California Univ., Berkeley.
TEMPERATURES AND VELOCITIES IN BUOYANT JETS Ph.D. Thesis
Mohammad Mehdi Behnia 1976 179 p
Avail: Univ. Microfilms Order No. 77-15604

Comparison of the numerical and integral method solutions for the buoyant turbulent jet discharging into unstratified surroundings of the same fluid show that essentially similar results are obtained when the property variation is small and appropriate turbulent parameters are used in the two kinds of calculation. Experimental results for temperatures and velocities of a jet of heated air indicate correspondence with the predictions which, for the integral method, involve Fox's specification of the entrainment coefficient for buoyancy, and a ratio of thermal to hydrodynamic widths. Both the numerical and integral method solutions indicate that the length of the potential region decreases with an increase in the buoyancy of the jet. The numerical and integral method solutions for the buoyant jet in stratified surroundings agree satisfactorily with the experimental results. The integral method solution for downward buoyant jet also shows satisfactory agreement with the experimental results. Dissert. Abstr.

N78-12360 California Univ., Berkeley.
EVAPORATION AND HEATING OF LAMINAR AND TURBULENT FALLING LIQUID FILMS Ph.D. Thesis
Amir Faghri 1976 257 p
Avail: Univ. Microfilms Order No. 77-15678

Governing equations for heat and mass transfer across a falling liquid film are solved numerically for heating, evaporation, and gas adsorption. Three distinct cases are considered: (1) thermal development of smooth laminar flow, (2) fully developed wavy falling film for evaporation, and (3) fully developed heat transfer coefficient and the effects of thermal entry length in the turbulent flow. For the latter part, the existing turbulent models which respectively predicted the heat transfer coefficient for fully developed evaporation and for heating of such films are modified and combined so that adequate predictions are made for both cases, both for the region of thermal development and for the asymptotic values of the transfer coefficient.
Dissert. Abstr.

N78-12361 New Mexico Univ., Albuquerque.
INVESTIGATION OF AN EJECTOR HEAT PUMP Ph.D. Thesis
Chowna Thupvongsa 1976 192 p
Avail: Univ. Microfilms Order No. 77-16123

The relative performance of heat driven ejector heat pumps suitable for possible low cost simple solar powered heating and cooling systems was evaluated. A procedure was developed for theoretical analysis of the ejector heat pump cycle using a digital computer. Freon-113 and 114 were selected for evaluation as working fluids because of their favorable phase equilibrium characteristics. Equations for the thermophysical properties of Freon-113 and 114 suitable for computer analysis were developed from published properties data. Finite difference equations for simulation of the ejector performance with Freon-113 and 114 were also developed and solved. The results indicate that Freon-113 and 114 experience a large increase of entropy in the ejector compression process. Thus, the ejector was relatively inefficient for these low density, dry vapor fluids. Dissert. Abstr.

N78-12362*# National Aeronautics and Space Administration, Washington, D. C.
EXPERIMENTAL INVESTIGATIONS ON SODIUM-FILLED HEAT PIPES
S. Dorner, F. Reiss, and K. Schretzmann Oct. 1977 20 p refs Transl. into ENGLISH from Experimentelle Untersuchungen an Natrium-Gefuellten Heat Pipes (Karlsruhe), report no. KFK-512, Jan. 1967 p 1-21 Transl. by Sci. Transl. Serv., Santa Barbara, Calif. Original doc. prep. by Kerforschungzentrum, Karlsruhe (West Germany)
(Contract NASw-2791)
(NASA-TM-75144) Avail: NTIS HC A02/MF A01 CSCL 20D

The possibilities of producing heat pipes and, especially, the necessary capillary structures are discussed. Several types of heat pipes were made from stainless steel and tested at temperatures between 400 and 1055 deg C. The thermal power was determined by a calorimeter. Results indicate: bubble-free evaporation of sodium from rectangular open chennels is possible with a heat flux of more than 1,940 W/sq cm at 1055 C. The temperature drop along the tube could be measured only at low temperatures. A subdivided heat pipe worked against the gravitational field. A heat pipe with a capillary structure made of a rolled screen was supported by rings and bars operated at 250 W/sq cm heat flux in the evaporating region. Author

N78-12363*# Cambridge Hydrodynamics, Inc., Mass.
STABILITY ANALYSIS FOR LAMINAR FLOW CONTROL, PART 1 Final Report
David J. Benney and Steven A. Orszag Washington NASA Oct. 1977 90 p refs
(Contract NAS1-14427)
(NASA-CR-2910; CHI-2) Avail: NTIS HC A05/MF A01 CSCL 20D

The basic equations for the stability analysis of flow over three dimensional swept wings are developed and numerical methods for their solution are surveyed. The equations for nonlinear stability analysis of three dimensional disturbances in compressible, three dimensional, nonparallel flows are given. Efficient and accurate numerical methods for the solution of the equations of stability theory were surveyed and analyzed. Author

N78-12364*# Martin Marietta Corp., Denver, Colo.
EFFECT OF VIBRATION ON RETENTION CHARACTERISTICS OF SCREEN ACQUISITION SYSTEMS Final Report, May 1976 - Jun. 1977
J. R. Tegart and A. C. Park Oct. 1977 167 p refs
(Contract NAS3-20097)
(NASA-CR-135264; MCR-77-253) Avail: NTIS HC A08/MF A01 CSCL 20D

An analytical and experimental investigation of the effect of vibration on the retention characteristics of screen acquisition systems was performed. The functioning of surface tension devices using fine-mesh screens requires that the pressure differential acting on the screen be less than its pressure retention capability. When exceeded, screen breakdown will occur and gas-free expulsion of propellant will no longer be possible. An analytical approach to predicting the effect of vibration was developed. This approach considers the transmission of the vibration to the screens of the device and the coupling of the liquid and the screen in establishing the screen response. A method of evaluating the transient response of the gas/liquid interface within the screen was also developed. Author

N78-12365*# National Aeronautics and Space Administration, Washington, D. C.
ACOUSTIC CONDITIONS IN THE VICINITY OF AN ORIFICE THAT DEPENDS ON GRAZING FLOW BOUNDARY LAYERS. AN EXPERIMENTAL INVESTIGATION Ph.D. Thesis
Jurgen Kompenhans Nov. 1977 68 p refs Transl. into ENGLISH from Das Akustische Verhalten Uberstroemter Oeffnungen in Abhaengigkeit von der Wangrenzschicht, eine Experimentelle Untersuchung (Goettingen), 1976 p 1-58 Transl. by Sci. Transl. Serv., Santa Barbara, Calif. Original doc. prep. by Goettingen Univ. (West Germany)
(Contract NASw-2791)
(NASA-TM-75146) Avail: NTIS HC A04/MF A01 CSCL 20D

The reflection factor at a tube which ends at a plate over which a flow is forming was determined as a function of the Strouhal number, formed from the flow velocity, the aperture radius, and the acoustic frequency. Several adjacent openings were investigated to determine the interactions between several openings. Author

N78-12366*# Cincinnati Univ., Ohio. Dept. of Aerospace Engineering and Applied Mechanics.
NUMERICAL METHODS FOR INVISCID/VISCOUS FLOWS
T. M. El-Mistikawy and M. J. Werle Sep. 1977 103 p refs
(Grant NsG-1208; Contract F33615-76-C-3091)
(NASA-CR-155328; AFL-77-9-34) Avail: NTIS HC A06/MF A01 CSCL 20D

A study of numerical schemes for solving viscous fluid flow problems with sizable regions of predominantly inviscid flow is presented. Difficulties associated with the familiar central difference approach for such problems were analyzed and alternative finite difference approaches employing windward concepts are presented. In addition, difference relations based on exponential operators were developed. All such schemes were demonstrated and evaluated through application to the case of Falkner Skan flow with blowing - a problem in which a sizable region of predominantly inviscid flow develops near the injection surface that traditionally causes numerical difficulty.
Author

N78-12367*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
INVESTIGATION OF PRESSURE OSCILLATIONS IN AXI-SYMMETRIC CAVITY FLOWS, PHASE 1 Final Report, 16 Feb.- 30 Sep. 1976
V. Sarohia and P. F. Massier Sep. 1977 39 p refs
(Contracts NAS7-100; DA MIPR R-77-25; DA Proj. 1W1-62114-AH-73)
(NASA-CR-155282; JPL-Pub-77-68; HDL-CR-77-025-1) Avail: NTIS HC A03/MF A01 CSCL 20D

Subsonic turbulent flows over shallow, axisymmetric cavities located downstream of the leading edge of a flat nose fuse contour and on an ellipsoidal nose contour, were studied. The objective was to evaluate cavity performance in terms of pressure oscillations inside the cavity for various cavity configurations and other pertinent parameters for various modes of cavity operation. It was found that pressure signals at the base of the cavity for an oscillating cavity flow as high as 150 db could be obtained and that a total acoustic power as high as 20 W was estimated. Furthermore, pressure oscillations existed for cavity depths as

small as 0.050 in. Cavity oscillations were more pronounced when the cavity was located in the negative pressure gradient region of the axisymmetric body. Instant spark shadowgraphs taken for both laminar and for turbulent boundary layer flow separation at the upstream cavity corner showed the presence of large, organized vortex structures in the oscillating shear layer. Author

N78-12368# Naval Postgraduate School, Monterey, Calif.
DATA ACQUISITION AND ANALYSIS TECHNIQUES FOR MEASUREMENT OF UNSTEADY WALL PRESSURES IN A TRANSONIC COMPRESSOR Interim Report, Oct. 1976 - Jun. 1977
J. M. Simmons Jul. 1977 80 p refs
(AD-A044478; NPS-67SF77071) Avail: NTIS HC A05/MF A01 CSCL 21/5

Real-time acquisition and analysis techniques have been developed for the measurement of unsteady wall pressures in a transonic compressor. The report contains listing and explantory notes for the computer codes and is intended as a guide to users of the system. Preliminary results are presented in the form of casing wall pressure contours. They demonstrate the effectiveness and versatility of the system in its ability to synchronize sampling of rapidly fluctuating signals with the rotation of the rotor. Author (GRA)

N78-12369# Ballistic Research Labs., Aberdeen Proving Ground, Md.
THE FLOW OF A LIQUID-VAPOR MIXTURE THROUGH A DUCT Final Report
William P. Walters and John Boyle Aug. 1977 37 p refs
(DA Proj. 1L1-61102-A-114)
(AD-A043994; BRL-MR-2779) Avail: NTIS HC A03/MF A01 CSCL 20/4

The critical and subcritical mass flow rate is calculated for a homogeneous, adiabatic, frozen, liquid-vapor mixture flowing through a vent with friction. A critical pressure ratio (defined based on the simplifying assumptions) and other fluid dynamic parameters are calculated. The model is an extension of the compressible, adiabetic, constant duct area gas dynamics equations with wall shear. In spite of the limiting assumptions, the model is in agreement with experimental data and other critical flow analytical models. The model is capable of predicting a critical pressure ratio, predicting flow rate for critical or subcritical flow, predicting all fluid properties of interest for either critical or subcritical flow, and the model employs a sonic velocity expression consistent with the assumptions. This model has been successfully employed to aid in predicting the pressure transients of nuclear reactor subcompartments following a postulated loss-of-coolant accident. Author (GRA)

N78-12370# Ohio State Univ. Research Foundation, Columbus.
WORKSHOP ON VISCOUS INTERACTION AND BOUNDARY-LAYER SEPARATION Final Report, 30 Jun. 1976 - 29 Jun. 1977
Odus R. Burggraf Aug. 1976 63 p refs Workshop held at Columbus, Ohio, 16-17 Aug. 1976
(Grant AF-AFOSR-3080-76)
(AD-A044423; AFOSR-77-1204TR) Avail: NTIS HC A04/MF A01 CSCL 20/4

The purpose of the workshop was to assess the current state of progress and to stimulate further efforts toward the goal of practical and reliable analysis of viscous flows at high Reynolds numbers. For definiteness, the scope of the workshop was limited to theoretical aspects of the subject, with emphasis placed on fundamental ideas and problem areas rather than on details of computations and results. Only abstracts of the papers were requested in order to promote informality and a free interchange of ideas. Each participant was given twenty minutes for a presentation on recent research efforts (in most cases work in progress was reported), followed by approximately ten minutes of lively discussion. GRA

N78-12371# AiResearch Mfg. Co., Phoenix, Ariz.
AN EQUATION SPLITTING METHOD FOR SHOCK BOUNDARY LAYER INTERACTION Final Report, 15 Jun. 1974 - 31 May 1977
P. R. Dodge and L. S. Lieber 31 Jul. 1977 47 p refs
(Contract N00014-74-C-0317)
(AD-A043902; Rept-21-2548) Avail: NTIS HC A03/MF A01 CSCL 20/4

An equation splitting numerical method for compressible separated flow is described. The basic equations are developed and solved. Comparison to a laminar shock boundary layer interaction is made. Results show qualitative agreement with discrepancies attributed to detail inaccuracies in the numerical methods. Rapid convergence and low computation times are realized. Author (GRA)

N78-12372# ARO, Inc., Arnold Air Force Station, Tenn.
AN EXPERIMENTAL INVESTIGATION OF DUCTED, REACTIVE, TURBULENT JET MIXING WITH RECIRCULATION Final Report, 26 Feb. - 26 Oct. 1976
D. E. Chriss Sep. 1977 47 p refs
(AD-A044110; ARO-ETF-TR-77-27; AEDC-TR-77-56; AFOSR-77-27TR) Avail: NTIS HC A03/MF A01 CSCL 20/4

An experimental investigation of ducted, two stream, subsonic, reactive, turbulent jet mixing with recirculation was conducted. A primary jet of air at a mass flow rate of 0.075 lb/sec and velocity of 700 ft/sec was surrounded by an outer, low velocity, hydrogen stream. Data were obtained with hydrogen-air ratios of 0.143 and 0.107. The duct-to-inner nozzle diameter ratio was ten. Radial distributions of hydrogen mass fraction, mean axial velocity, turbulence intensity, and total pressure as well as axial distributions of wall hydrogen mass fraction and wall static pressure are presented for axial stations from one-half to five duct diameters from the nozzle exit plane. Comparison of the experimental data with calculations assuming frozen or equilibrium chemistry indicate that he measured velocity, pressure, and composition data are, in general, self-consistent. The maximum turbulent intensities which occurred in the center of the mixing layer and within the recirculation eddy were very high having values of 20 percent of the jet exit velocity. The velocity and composition field indicate that, while and mixing in the reactive flow field is slower than for the nonreactive case, the reaction had little effect on the size and location of the recirculation zone within the mixing duct. GRA

N78-12373# Air Force Systems Command, Wright-Patterson AFB, Ohio.
THE THEORY OF THE UNSTEADY FILTRATION OF LIQUID AND GAS
G. I. Barenblatt, V. M. Yentov, and V. M. Ryzhik 24 Jan. 1977 477 p refs Transl. into ENGLISH from Izd-vo "Nedra" (USSR), 1972 p 1-146
(AD-A044774; FTD-ID(RS)T-1860-76-Pt-1) Avail: NTIS HC A21/MF A01 CSCL 13/11

Contents: Physical Bases; Basic Problems of Unsteady Filtration; The Theory of the Elastic Conditions of Filtration; Nonlinear Invariant Problems of the Unsteady Filtration of Liquids and Gases; and Approximation Methods of the Solution of the Problems of Unsteady Filtration. GRA

N78-12374# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE THEORY OF THE UNSTEADY FILTRATION OF LIQUID AND GAS, PART 3
G. I. Barenblatt, V. M. Yentov, and V. M. Ryzhik 24 Jan. 1977 465 p refs Transl. into ENGLISH from "Teoriya Nestatsionarnoy Filtratsii Zhidkosti i Gaza" (USSR), Izd. Nedra, 1972 p 147-288
(AD-A044775; FTD-ID(RS)T-1860-76-Pt-3) Avail: NTIS HC A20/MF A01 CSCL 13/11

The following topics are considered: (1) the filtration of inhomogeneous liquids - unsteady filtration in cracked porous material and in material with dual porosity and stratified rocks; (2) nonlinear unsteady filtration - special problems in the nonstationary filtration of homogeneous liquid and special problems in the unsteady filtration of inhomogeneous liquid. GRA

N78-12375# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
HYDRAULIC DRIVE AND HYDROPNEUMOAUTOMATION, PART 1
T. M. Bashta 15 Feb. 1977 661 p refs Transl. into ENGLISH

from "Gidropribod i Gidropnevmoavtomatika', Moscow, Izd. Mashinostroyeniye, 1972 p 1-320
(AD-A044695; FTD-ID(RS)T-0109-77-Pt-1) Avail: NTIS HC A99/MF A01 CSCL 13/7

The following topics are considered: (1) principles of applied hydraulics; working fluids and their properties; (2) actuating mechanisms; (3) devices and apparatuses of distribution and control; (4) hydraulic servomechanisms and hydraulic boosters; (5) circuits of standard hydraulic systems and their elements and basic calculations; (6) packing of the connections of hydraulic systems; (7) decontamination filtration of working fluids; and (8) pneumatic gas drives. GRA

N78-12376# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
HYDRAULIC DRIVE AND HYDROPNEUMOAUTOMATION, PART 2
T. M. Bashta 15 Feb. 1977 623 p refs Transl. into ENGLISH from the book "Gidroprivod i Gidropenvmoavtomatika" Moscow, Izd. Mashinostroyeniye, 1972 p 159-320
(AD-A044696; FTD-ID(RS)T-0109-77-Pt-2) Avail: NTIS HC A99/MF A01 CSCL 13/7

Contents: Chapter I. Principles of Applied Hydraulics. Working Fluids and Their Properties; Chapter II. Actuating Mechanisms; Chapter III. Devices (Apparatuses) of Distribution and Control; Chapter IV. Hydraulic Servomechanisms (Hydraulic Boosters); Chapter V. Circuits of Standard Hydraulic Systems Their Elements and Basic Calculations. Circuits of Standard Hydraulic Systems; Chapter VI. Packing of the Connections of Hydraulic System; Chapter VII. Decontamination (Filtration) of Working Fluid; and Chapter VIII. Pneumatic (Gas) Drives. GRA

N78-12377# Naval Postgraduate School, Monterey, Calif.
AN INVESTIGATION OF ELECTRO-OPTICAL TURBULENCE PARAMETERS M.S. Thesis
Valente Macias, Jr. Jun. 1977 69 p refs
(AD-A044477) Avail: NTIS HC A04/MF A01 CSCL 04/1

Mean humidity, temperature, wind data and fluctuating temperature and velocities data obtained from the R/V Acania were interpreted on the basis of empirically derived expressions describing the temperature structure parameter, (C sub T) squared, and the dissipation rate of turbulent kinetic energy, epsilon. Properties of (C sub T) squared and epsilon are related to a stability parameter Z/L and the Richardson number, Ri. Non-dimensional temperature structure functions parameters, (C sub T) squared Z to the 4/3 power (partial deriv. of theta with respect to Z) squared and turbulent kinetic energy dissipation rates, (Kepsilon ZU*) to the (-3) power, versus Ri were examined for open ocean conditions. This experiment verified earlier hypotheses that the profiles obtained from empirically derived expressions using overwater data are very much different from those obtained using overland data. The distribution of the non-dimensional turbulent kinetic energy dissipation rate agreed with that predicted by similarity theory. Author (GRA)

N78-12378# Ballistic Research Labs., Aberdeen Proving Ground, Md.
SHOCK PROPAGATION IN THE ONE-DIMENSIONAL LATTICE
John D. Powell and Jad H. Batteh Aug. 1977 84 p refs
(DA Proj. 1L1-61102-AH-43)
(AD-A044791; BRL-2009) Avail: NTIS HC A05/MF A01 CSCL 20/2

Shock propagation in a one-dimensional, discrete lattice is studied in some detail both by reviewing existing treatments of the problem and by providing a number of extensions to those treatments. Although some analytic work is presented, most of the study is in the form of a computer simulation. The purpose of the simulation is to solve numerically the classical equations of motion of the atoms of the lattice as they respond to the shock wave. Various forms of interatomic potential are considered and the resulting differences are noted and discussed. The effect of the initial state of the lattice upon the shock profile is studied by considering two sets of initial conditions. In the first, the atoms are at rest in their equilibrium positions prior to compression by the shock wave; in the second, the lattice is initially in thermal equilibrium at approximately room temperature. All anharmonic potentials studied are found to support the propagation of well-defined, stable pulses (solitons) and the physical implications of these rather unusual pulses are examined. Specific future investigations are recommended and their relevance to Army-related problems is explained. Author (GRA)

N78-12379# Air Force Systems Command, Wright-Patterson AFB, Ohio. Translation Div.
HYDROMECHANICAL PROPERTIES OF AN ISOLATED WING MOVING ABOVE A SCREEN
S. V. Kovalchuk and I. P. Tkachenko 3 Feb. 1977 19 p refs Transl. into ENGLISH from Gidrodinamika Bolshikh Skorostey (USSR), no. 1, 1965 p 119-127
(AD-A044692; FTD-ID(RS)I-0041-77) Avail: NTIS HC A02/MF A01 CSCL 20/4

The hydromechanical characteristics of a wing moving near the interface of two media are described. Increasing lift, decreasing drag, and displacing the center of pressure along the wing chord are the factors which are considered when constructing airfoil systems and determine the approach to the problem of the stability of the device. I.M.

N78-12380# Binary Systems, Inc., Silver Spring, Md.
MAXIMUM-LIKELIHOOD FLOW-SPEED ESTIMATION Interim Report
S. Gardner and F. L. Rees 24 May 1977 69 p
(Contract N00014-72-C-0318; RR03010384)
(AD-A044681; WB77-1) Avail: NTIS HC A04/MF A01 CSCL 20/4

The design formulae and theoretical performance of a maximum-likelihood estimator for towed-array flow-speed estimation are discussed. Under appropriate conditions, it is shown that a maximum-likelihood estimate of convection velocity (which is related to tow speed) is achieved by performing a cross correlation between the outputs of two streamwise-separated flush-mounted surface probe hydrophones. The estimate, then, is derived by seeking the time delay which maximizes the cross correlation. Conditions are examined consistent with achieving accurate speed determination to within a fraction of a knot. Fortuitously, the method derived has the property that, as speed is increased, both the level and bandwidth of the pressure signals increase, thus providing increased signal-to-noise ratio and more accurate time-delay information. GRA

N78-12381# Air Force Aero Propulsion Lab., Wright-Patterson AFB, Ohio.
A CASCADE IN UNSTEADY FLOW Final Report, Nov. 1969 - Jun. 1975
Francis R. Ostdiek Dec. 1976 268 p refs
(AF Proj. 3066)
(AD-A045319; AFAPL-TR-76-115) Avail: NTIS HC A12/MF A01 CSCL 20/4

The flow velocity in an axial compressor, with a distorted inlet pressure profile or rotating stall cells, is unsteady in both magnitude and direction with the unsteadiness in direction having a more abrupt effect on airfoil performance. The objective of this research was to obtain pressure distributions and pressure histories on both surfaces on an airfoil in a cascade while it is undergoing a sinusoidal variation in angle of attack. GRA

N78-12382# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
HEAT-TRANSMITTING TUBES
L. L. Vasilyev and S. V. Konev 17 Mar. 1977 322 p refs Transl. into ENGLISH of the book "Teploperedayushiye Trubki" Minsk, Izd. Nauka i tekhn., 1972 p 1-151
(AD-A044667; FTD-ID(RS)T-0165-77) Avail: NTIS HC A14/MF A01 CSCL 13/1

This book describes different forms of low temperature thermal tubes. Presented are the theoretical principles of the heat and mass exchange processes taking place. Considerable attention is placed on the transport properties of capillary-porous cores, and to their use in cooling radio-electronics equipment. GRA

N78-12383# Stanford Univ., Calif. Dept. of Civil Engineering.
THE STRUCTURE OF MODULATED TURBULENT FLOW OVER PROGRESSIVE WATER WAVES Interim Technical Report
Chin-Tsau Hsu, En. Y. Hsu, and Robert L. Street Aug. 1977

228 p refs
(Contract N00014-76-C-0155; Grants DAAG29-76-G-0125; NSF ENG-76-15106)
(AD-A044743; TR-221) Avail: NTIS HC A11/MF A01 CSCL 08/3

Theoretical predictions of wave growth by closure modelling have been hindered by the ambiguity about the interface conditions and the lack of knowledge of the dynamics of wave-turbulence interaction. The present experimental program was undertaken in an attempt to clarify the interface flow structure, as well as the closure relations, and to study the dynamic response of wave perturbations to the imposition of air modulations. GRA

N78-12384# Polytechnic Inst. of New York, Farmingdale.
AN INTEGRAL SPLINE METHOD FOR BOUNDARY LAYER EQUATIONS Interim Report
S. G. Rubin and P. K. Khosla Jul. 1977 45 p refs
(Grant AF-AFOSR-2635-74)
(AD-A044571; POLY-M/AE-77-12; AFOSR-77-1210TR) Avail: NTIS HC A03/MF A01 CSCL 20/4

An integral procedure using spline polynomials is described for the two dimensional boundary layer equations. This is a modified finite-element (MFE) formulation, wherein each term in the equations, rather than each independent variable, is approximated with a spline curve fit. Therefore, this is not a true finite-element or Galerkin method and the conventional spline relationships between functional and derivative values still apply. The only difference between the present integral formulation and our earlier differential collocation procedures is in the treatment of the governing differential equations. The differential methods are more suited to non-conservation equations; the present integral formulation is more desirable for conservation or divergence form of the equations. Boundary layer solutions using conventional second-order finite difference collocation, the second and fourth order Keller Box Scheme, and fourth order spline collocation or MFE methods are compared. Conservation and non-conservation forms are considered. Finally, the extension of the MFE formulation to three-coordinate parabolic systems and for the transonic small disturbance equations is briefly described. Author (GRA)

N78-12385# Construction Engineering Research Lab. (Army), Champaign, Ill.
LIQUID-SPRING SHOCK ISOLATOR MODELING Final Report, Jul. 1975 - Aug. 1976.
P. N. Sonnenburg, B. H. Wendler, and W. E. Fisher Sep. 1977 58 p refs
(DA Proj. 4A7-62719-AT-40)
(AD-A044993; CERL-TR-M-226) Avail: NTIS HC A04/MF A01 CSCL 20/4

The purpose of this pilot study was to determine whether mathematical models of high-performance shock isolators could be established from test performance data. A liquid spring was modeled using an open-parameter differential equation. A system identification technique was used to select the best algebraic form of the model and to optimize the parameters for the sample isolator. A comparison of the calculated response variables with the test data showed that the model was accurate and that isolator models could generally be established in this manner. The use of the isolator mathematical model and determination of optimum constant parameters for practical design purposes is discussed. However, conversion of this information to actual hardware design dimensions warrants further research and is not addressed. Author (GRA)

N78-12386# Polytechnic Inst. of New York, Farmingdale. Aerodynamics Labs.
COMPUTATION OF SHOCK LAYERS ABOUT ABLATED, BLUNT-NOSED BODIES Interim Report
Gino Moretti Aug. 1977 48 p refs
(Contract N00014-75-C-0511)
(AD-A044619; Poly-M/AE-77-14) Avail: NTIS HC A03/MF A01 CSCL 20/4

A technique is described to calculate steady, inviscid, supersonic flows past blunt-nosed vehicles affected by ablation. New computational grids are created by conformal mapping. Stretching of coordinates for further application to viscous flows is demonstrated. The technique does not apply to flows with imbedded shocks. Author (GRA)

N78-12387# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
APPROXIMATE NONLINEAR THEORY OF RECTANGULAR WING OF SMALL ASPECT RATIO MOVING NEAR A FLUID SCREEN AT LARGE FROUDE NUMBERS
K. K. Fedyayevskiy 2 Feb. 1977 25 p refs Transl. into ENGLISH from the book "Giproaerodinamika Nesushchikh Proverkhnostey" Kiev, Naukova Dunka, 1966 p 24-34
(AD-A044693; FTD-ID(RS)I-0043-77) Avail: NTIS HC A02/MF A01 CSCL 20/4

From the experimentally determined moment value the moment of inertial nature, i.e., the ascent corresponding to the circulation-free flow past the body is subtracted and the difference is divided by lifting force, coemcients of increased resistance, and coefficients of the center of pressure of a thin wing with an aspect ratio of A = 0.25 for several relative immersions. The substantial nonlinearity of the ascent coefficient results in a situation where the center of pressure moves rather rapidly toward the trailing edge of the wing as the angle of attack increases. Author

N78-12388# Aeronautical Research Associates of Princeton, Inc., N. J.
MODELING TWO-PHASE FLOW IN A SWIRL COMBUSTOR Technical Progress Report, 1 Feb. - 1 Apr. 1977
Harvey Segur, Ashok K. Varma, and W. S. Lewellen Apr. 1977 21 p
(Contract EY-76-C-02-4062)
(COO-4062-4; ARAP-77-2) Avail: NTIS HC A02/MF A01

Work has been concentrated on two tasks: (1) exercising the model both to verify its internal consistency and to provide some estimates of design geometry scaling; and (2) analyzing the cylindrical wall layer in more detail. These tasks are reported separately. ERA

N78-12389# California Univ., Livermore. Lawrence Livermore Lab.
KEG, AN EULERIAN CONFIGURATION GENERATOR FOR BBC AND VOA
Stephen I. Warshaw May 1977 74 p refs
(Contract W-7405-eng-48)
(UCID-17461) Avail: NTIS HC A04/MF A01

The operating details for the use of KEG, the contents of the input deck required to set up a problem to be calculated on the BBC or VOA, and other miscellanea related to output and file handling are described. ERA

35 INSTRUMENTATION AND PHOTOGRAPHY

Includes remote sensors; measuring instruments and gages; detectors; cameras and photographic supplies; and holography.

For aerial photography see *43 Earth Resources*. For related information see also *06 Aircraft Instrumentation*, and *19 Spacecraft Instrumentation*.

N78-12390* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
LOW GRAVITY PHASE SEPARATOR Patent
George F. Smoot (Calif. Jniv., Berkeley), William L. Pope (Calif. Univ., Berkeley), and Lawrence Smith, inventors (to NASA) (Calif. Univ., Berkeley) Issued 7 Jun. 1977 6 p Filed 12 Sep. 1975 Supersedes N75-32262 (13 - 23, p 2897) Sponsored by NASA
(NASA-Case-MSC-14773-1; US-Patent-4,027,494; US-Patent-Appl-SN-612966; US-Patent-Class-62-50; US-Patent-Class-55-3; US-Patent-Class-55-100; US-Patent-Class-55-26-9; US-Patent-Class-62-514R; US-Patent-Class-137-197; US-Patent-Class-210-222) Avail: US Patent Office CSCL 14B

An apparatus is described for phase separating a gas-liquid

mixture as might exist in a subcritical cryogenic helium vessel for cooling a superconducting magnet at low gravity such as in planetary orbit, permitting conservation of the liquid and extended service life of the superconducting magnet.
Official Gazette of the U.S. Patent Office

N78-12391 New Mexico Univ., Albuquerque.
IMPROVED METHODS OF MAXIMUM A POSTERIORI IMAGE RESTORATION Ph.D. Thesis
Henry Joel Trussell 1976 85 p
Avail: Univ. Microfilms Order No. 77-16125

An explanation is presented of why and how maximum a posteriori (MAP) image restoration works. A new numerical iteration scheme is derived on the basis of this explanation with a convergence criterion related to the noise process. This numerical scheme is very similar to the modified Picard's method given in standard numerical analysis texts. The effects of the parameters of the MAP restoration method are predicted by the explanation and confirmed by experiment. The MAP restoration method is further improved by using local processing, i.e., processing small sections of the image sequentially and piecing them together to form the restored image. It was found, as predicted, that smaller section sizes result in better restorations. Computing costs increase as section sizes decrease. Although the improved MAP restoration scheme is over ten times more efficient than the old scheme, the method remains costly compared to more standard techniques. The method can be used as a refinement technique by post processing the output of other restoration methods. Dissert. Abstr.

N78-12392 California Univ., Berkeley.
X-RAY LITHOGRAPHIC FABRICATION OF BLAZED DIFFRACTION GRATINGS Ph.D. Thesis
Paul Isaac Hagouel 1976 187 p
Avail: Univ. Microfilms Order No. 77-15707

An X-ray lithographic fabrication technique suitable for the fabrication of blazed diffraction gratings is presented. The technique is based on a soft X-ray replication of an absorbing grating mask pattern with either one or two source exposures. It is particularly appropriate for producing high efficiency small period diffraction gratings. The X-ray lithographic fabrication technique allows for the use of a single mask to replicate gratings with a variety of blaze angles. A numerical method suitable for simulating the development process of exposed resists is also presented. The method is based on an analogy to geometrical optics (ray-tracing). It is suitable for simulating the time evolution of two dimensional line edge profiles produced by a locally rate dependent surface etching phenomenon. It can be conveniently adapted to three dimensional problems. Dissert. Abstr.

N78-12393*# Martin Marietta Corp., Denver, Colo.
PHOTO SENSOR ARRAY TECHNOLOGY DEVELOPMENT
M. W. Rossman, V. F. Young, and J. R. Beall Dec. 1977 66 p refs
(Contract NAS1-14190)
(NASA-CR-145269; MCR-77-563) Avail: NTIS HC A04/MF A01 CSCL 14E

The development of an improved capability photo sensor array imager for use in a Viking '75 type facsimile camera is presented. This imager consists of silicon photodiodes and lead sulfide detectors to cover a spectral range from 0.4 to 2.7 microns. An optical design specifying filter configurations and convergence angles is described. Three electronics design approaches: AC-chopped light, DC-dual detector, and DC-single detector, are investigated. Experimental and calculated results are compared whenever possible using breadboard testing and tolerance analysis techniques. Results show that any design used must be forgiving of the relative instability of lead sulfide detectors. A final design using lead sulfide detectors and associated electronics is implemented by fabrication of a hybrid prototype device. Test results of this device show a good agreement with calculated values. Author

N78-12394# Air Force Rocket Propulsion Lab., Edwards AFB, Calif.
A MICROPHOTOGRAPHIC STUDY OF AN EPOXY BOND SYSTEM FOR SEMICONDUCTOR STRESS TRANSDUCERS
Thomas J. C. Chew and Daniel H. Banasiak Aug. 1977 35 p (AF Proj. 5730)
(AD-A044432; AFRPL-TR-77-39) Avail: NTIS HC A03/MF A01 CSCL 11/9

A specimen of epoxy bonded silicon strain gage was photographed at various angles and localities using a Quick Scanning Electron Microscope. The specimen was magnified up to 5,000 times. Epoxy fillet size variation, epoxy filler particles and metal surface texture were recorded. Relatively large dust particles were also found on the specimen surface. Consequently, an energy dispersion elemental analysis was performed on two arbitrarily selected dust particles and found that their predominant composition was aluminum. The specimen was then ground in successive planes perpendicular to the length of the silicon gage. Ten such specimen cross-sections were photographed at 500X magnification. These photographs were analyzed for the magnitude and variation of epoxy thickness, gage thickness and gage width. GRA

N78-12395# Sandia Labs., Albuquerque, N. Mex. Explosives and Energy Devices Div.
DEVELOPMENT AND USE OF A CONTINUOUS VELOCITY-OF-DETONATION SENSOR
William D. Harwood Mar. 1977 24 p refs
(Contract EY-76-C-04-0789)
(SAND-77-0177) Avail: NTIS HC A02/MF A01

A device to improve the capabilities for measurement of detonation velocity in linear explosive devices was developed. The device provides continuous measurement of the rate of propagation over a section of linear explosive somewhat longer than 100 mm. The use of the device in conjunction with conventional lightpipe sensing to generate redundant data is discussed. Estimates of the precision of the measuring system are presented. ERA

N78-12396# Sandia Labs., Albuquerque, N. Mex.
CONSTRUCTION AND TESTING OF A VAPORIZATION CALORIMETER FOR ASSAY OF RADIOISOTOPIC SAMPLES
H. P. Stephens Mar. 1977 38 p refs
(Contract EY-76-C-04-0789)
(SAND-77-0105) Avail: NTIS HC A03/MF A01

A laboratory model vaporization calorimeter was constructed to test the feasibility of the technique for assay of radioisotopic samples. As a result of over 80 experiments, including calibrations and measurements of Pu-238 radioisotopic power sources, it was found that relative precision of the calorimeter ranges from 0.24 percent at 3.1 watts to 2.7 percent at 9 mW. The assay time was found to decrease with increasing power: from 4.8 hours at 9 mW to 1.3 hours at 3.1 watts. It appears that the vaporization calorimetry technique provides a promising tool for nondestructive assay of radioisotopic samples which emit easily absorbed radiations (alpha beta). Several improvements in the design were noted. ERA

N78-12397# Transportation Systems Center, Cambridge, Mass.
GENERAL VEHICLE INSTRUMENTATION EVALUATION Final Report
Lowell V. Babb Mar. 1977 214 p
(PB-269598/9; DOT-TSC-UMTA-77-12; UMTA-MA-06-0025-77-9) Avail: NTIS HC A10/MF A01 CSCL 14B

A general Vehicle Test System (GVTS) was developed by the Transportation Systems Center to facilitate rail transit vehicle testing at the Transportation Test Center (TTC), Pueblo, Colorado. The system was designed to be responsive to requirements specified. The results of evaluation tests carried out on the GVTS at the TTC, Pueblo, Colorado, in May 1975 are presented. The GVTS is an integrated instrumentation system consisting of transducers, signal conditioners, signal filters, interface and control electronics, a data acquisition system, signal monitoring and output devices, and all related hardware and software. The objective of the test series is to evaluate the performance of the instrumentation system under actual rail transit operating conditions. GRA

N78-12398# ARO, Inc., Arnold Air Force Station, Tenn.
DEVELOPMENT OF A LASER VELOCIMETER SYSTEM FOR FLAME STUDIES Final Report, Jul. 1973 - Feb. 1976

H. T. Bentley and B. W. Bomar Jan. 1977 56 p refs Submitted for publication
(Contract EPA-IAG-189(D))
(PB-270514/3; ARO-OMD-TR-76-78; AEDC-TR-76-150; EPA-600/2-77-007-77) Avail: NTIS HC A04/MF A01 CSCL 14B

The development of a two-component laser velocimeter system for measuring velocity in the flame zone of research-scale combustors is described. Results of a feasibility investigation to assess the practicality of making laser velocimeter measurements in a reacting, highly turbulent, highly luminous environment are included. Optical path stability was evaluated and spectral radiance data was obtained. The system design that resulted employs a two-dimensional Bragg cell to enable entrained particle velocity and direction to be measured in two components. GRA

36 LASERS AND MASERS

Includes parametric amplifiers.

N78-12399 California Univ., Berkeley.
ULTRASHORT PULSES FROM DYE LASERS Ph.D. Thesis
Zafer Ahmet Yasa 1976 114 p
Avail: Univ. Microfilms Order No. 77-15922

Tunable ultrashort pulse generation mechanisms in dye lasers by passive and double mode-locking and synchronous pumping are studied. A general formalism is given by which the evolution of the ultrashort pulse from an initial sample of cavity field fluctuations can be readily investigated numerically. Such case studies are presented for the three methods considered. Exact stable pulse energies for passive mode-locking are computed for varying fundamental system parameters. Simple expressions for the stable pulse energy are provided which yield excellent agreement with the exact results. It is theoretically determined that the ratio of the effective absorption cross-section of the absorbing dye to the emission cross-section of the laser dye must be kept small in the typical moderate power pumped passive mode-locking configurations, in coincidence with experimental observations. Dissert. Abstr.

N78-12400
PLANAR AND INVERTED-RIDGE GaAs WAVEGUIDE LASERS: DEVICE CHARACTERISTICS AND STUDIES OF LIQUID-PHASE EPITAXY GROWTH Ph.D. Thesis
Dan Botez 1976 243 p
Avail: Univ. Microfilms Order No. 77-15615

A full description of the LPE system, growth techniques and results is given. In addition, the LPE process is treated from a chemical thermodynamic viewpoint, and the agreement of experimental results with theory is discussed. A description and analysis of the devices fabricated: optically pumped waveguide laser with distributed Bragg reflectors, and room-temperature pulsed injection lasers are described. An original study of growth characteristics of liquid-phase epitaxy over chemically etched channels in GaAs is given. Dissert. Abstr.

N78-12401*# Laser Analytics, Inc., Lexington, Mass.
ADVANCED DEVELOPMENT OF Pb-SALT SEMICONDUCTOR LASERS FOR THE 8.0 TO 15.0 MICROMETER SPECTRAL REGION Final Report
Kurt J. Linden, Jack F. Butler, and Kenneth W. Nill Oct. 1977 103 p refs
(Contract NAS1-14448)
(NASA-CR-145259) Avail: NTIS HC A06/MF A01 CSCL 20E

The technology was studied for producing Pb-salt diode lasers for the 8-51 micron spectral region suitable for use as local oscillators in a passive Laser Heterodyne Spectrometer (LHS). Consideration was given to long range NASA plans for the utilization of the passive LHS in a space shuttle environment. The general approach was to further develop the method of compositional interdiffusion (CID) recently reported, and used successfully at shorter wavelength. This technology was shown to provide an effective and reproducible method of producing a single-heterostructure (SH) diode of either the heterojunction or single-sided configuration. Performance specifications were exceeded in several devices, with single-ended CW power outputs as high as 0.88 milliwatts in a mode being achieved. The majority of the CID lasers fabricated had CW operating temperatures of over 60K; 30% of them operated CW above the boiling temperature of liquid nitrogen. CW operation above liquid nitrogen temperature was possible for wavelengths as long as 10.3 microns. Operation at 77K is significant with respect to space shuttle operations since its allows considerable simplification of cooling method. Author

N78-12402# Army Aeromedical Research Lab., Fort Rucker, Ala.
OPTICAL CHARACTERISTICS OF LASER SAFETY DEVICES Final Report
Wuv C. Chiou Jun. 1977 45 p refs
(AD-A044396; USAARL-77-17) Avail: NTIS HC A03/MF A01 CSCL 06/17

Six types of laser protective eyewear were evaluated in terms of their optical properties and spectral characteristics. These six types cover the protection of almost the entire visible spectrum. Type GG-9 and Type OG530 can be used to protect the He-Ne laser (at 633 nm), type OG-590 and type RG-610 are for argon laser (at 500 nm). Type BG-18 is for Ruby laser (at 694 nm) and type KG-3 are for Nd: glass laser (at 1060 nm) or CO2 laser (at 1060 nm). The optical properties and spectral characteristics are investigated by means of average and full spectral transmittance as well as their corresponding CIE chromaticity coordinate values. Results suggested that one type of the protective device should be used only for the specific laser. Furthermore, the device should not be used when a detection of a chromatic display or light source is required. Author (GRA)

N78-12403# Army Electronics Command, Fort Monmouth, N. J. Combat Surveillance and Target Acquisition Lab.
CATHODE LIMITED OPERATION OF TRANSVERSELY EXCITED CARBON DIOXIDE CHANNEL WAVEGUIDE
A. Papayoanou Jul. 1977 25 p refs
(DA Proj. 1T1-61101-A-91A)
(AD-A044052; ECOM-4510) Avail: NTIS HC A02/MF A01 CSCL 20/5

The discharge, gain and oscillator characteristics of transversely excited CO2 gas mixes was investigated under pulsed and CW conditions. A 1.6 mm square channel having a segmented upper electrode structure and a solid copper electrode with dielectric sidewalls formed the discharge chamber. Resistive loading of the individual discharge segments precluded arcing and insured glow discharges. However, the discharges were not wall confined except at pressures below 100 Torr, thereby reducing wall cooling and complete volumetric excitation. For low pressures a large fraction of the energy was deposited in the cathode fall region. At higher pressures the luminous glow discharge column narrowed and the ratio of the power dissipated in the cathode fall region decreased. However, the total power and power densities deposited in this region increased. The high electric fields and gas temperatures in this region dissociate and ionize molecules thereby limiting sealed-off lifetimes. Diffusion of heat into the adjoining gas creates turbulence and limits the gain. Detailed analysis of the negative aspects of the cathode fall region and nonuniform volume excitation suggests those areas where improvement is most essential. Certain improvements can be obtained by revising the construction of these devices. It remains essential, however, to limit the negative aspects of the cathode fall region and the Malter effect is suggested as one possible means of accomplishing this. Author (GRA)

N78-12404# United Technologies Research Center, East Hartford, Conn.
FREE-VORTEX AERODYNAMIC WINDOW LEAKAGE INVESTIGATION Final Report, 1 Jan. 1973 - 30 Jun. 1977
Mark D. Krosney and Roy N. Guile Aug. 1977 65 p refs
(Contract F44620-73-C-0031)
(AD-A044422; UTRC/R77-912076-3; AFOSR-77-1205TR)
Avail: NTIS HC A04/MF A01 CSCL 20/4

An experimental program was conducted to investigate the source of the leakage across a free-vortex aerodynamic window and to examine methods of reducing this leakage. Characterization of the endwall boundary layer flow via flow visualization techniques and pitot pressure measurements shows that the endwall boundary

layer flow is deflected toward the free-vortex center and portions of it are ingested into the simulated laser cavity connecting duct. Passive boundary layer control by means of a base region, circumferential to the simulated laser cavity connecting duct aperture along the free-vortex inner boundary, decreased the minimum connecting duct pressure obtainable from 71 to 46 torr by reducing the amount of endwall boundary layer flow that was ingested by the connecting duct. Active boundary layer control via energization with high velocity air also reduced leakage into the connecting duct; but, because of deleterious interactions of the boundary layer flow with the nozzles used to inject the energization flow, no net improvement in the value of the ambient-to-cavity pressure ratio over the passive boundary layer control technique was obtained. Also, it was demonstrated that the free-vortex aerodynamic window can be used to exhaust purge gas flow from the simulated laser cavity connecting duct without severely compromising its performance as an aerodynamic window. Author (GRA)

N78-12404# Physical Sciences, Inc., Woburn, Mass.
THEORETICAL STUDY OF LASER-INDUCED BREAKDOWN IN PARTICLE-CONTAMINATED AIR Final Report, 15 Sep. 1976 - 15 Mar. 1977
R. G. Root, P. K. S. Wu, and A. N. Pirri May 1977 98 p refs
(Contract N00173-76-C-0329)
(AD-A044073; PSI-TR-91) Avail: NTIS HC A05/MF A01 CSCL 20/5

Of the physical effects that limit the propagation of a high intensity laser beam through the atmosphere, air breakdown has the most catastrophic influence. Completely ionized air attenuates 10.6 micron radiation within a few centimeters. It is therefore imperative that the threshold for air breakdown under realistic circumstances be determined. In this report the physics of long pulse laser-induced breakdown process in particle-contaminated air is studied in four stages. The first stage is particulate heating and vaporization. Simple models are used to predict the time to vaporization at the particle surface, the time to vaporize a given fraction of the particle, and the pressure of the vapor immediately above the particle surface. The second stage is the heating of the vapor cloud. The heating rate is calculated under two approximations. The third stage of the breakdown process is the creation of air plasma. An estimate is made of the temperature the surrounding air must reach in order to readily absorb the laser energy. Then, from crude estimates of the energy flux into the air, the rate of expansion of the plasma into the air is determined. The final stage is the growth of the air plasma. The growth is followed as a function of time for various values of the initial air plasma size and the laser intensity. GRA

N78-12406# Massachusetts Inst. of Tech., Cambridge. Div. of Sponsored Research.
RESEARCH ON MATERIALS FOR HIGH POWER LASER WINDOWS Semiannual Report, 1 Dec. 1975 - 31 May 1976
H. K. Bowen, R. M. Cannon, F. A. McClintock, and J. B. VanderSande Nov. 1976 48 p refs
(Contract F19628-75-C-0191; ARPA Order 2055)
(AD-A044059; RADC-TR-76-348; SAR-2) Avail: NTIS HC A03/MF A01 CSCL 17/5

The theory for impurity drag on the grain boundary mobility in KCl has been modified to include a secondary interaction force such as would result from a size misfit between the solute and matrix ions. For aliovalent solutes the interactions are coupled. Near the isoelectric temperature the modified drag is much greater than that predicted for an electrostatic interaction. A simplified model has been developed which indicates the conditions under which a fluctuation in velocity along a boundary may grow and cause a segment of boundary to make the transition between the low and high velocity modes. Forged CaF2 samples have been examined by optical and transmission electron microscopy. There is a subgrain structure and the subgrain size decreases with increasing flow stress. Recrystallization which removes the subgrains can also occur during forging and during cooling. Recrystallization has been observed at temperatures as low as 600 C and is a serious problem above 800 C for pure samples. GRA

N78-12407# Army Missile Research and Development Command, Redstone Arsenal, Ala. Guidance and Control Directorate.
THE DEVELOPMENT OF A DISTURBANCE ACCOMMODATING CONTROLLER TO REDUCE "SPOT JITTER" IN A PRECISION POINTING SYSTEM: A PRACTICAL DESIGN GUIDE
William W. Malcolm, Jackson H. Priest, and Larry D. McTigue 1 Jul. 1977 72 p refs
(DA Proj. 1W3-62303-A-214)
(AD-A044434; DRDMI-TG-77-21) Avail: NTIS HC A04/MF A01 CSCL 19/5

Results of applying Disturbance Accommodating Control (DAC) theory to a precision pointing system are presented. Reductions in stabilized mirror spot jitter of up to 10:1 were achieved in side-by-side testing with the same system utilizing conventional servo design. From the lessons learned during hardware development and test, practical design guidelines are developed for achieving even better performance in future application of DAC design techniques. It is concluded that the technology has now been developed and demonstrated to where it is a viable candidate for design of operational precision pointing/tracking stabilization control systems. Author (GRA)

N78-12408# Chicago Univ., Ill. Dept. of Chemistry.
LASER SPECTROSCOPY IN SUPERSONIC JETS Interim Report
Donald H. Levy, Lennard Wharton, and Richard E. Smalley 1977 43 p refs
(Grant AF-AFOSR-2853-75)
(AD-A044718; AFOSR-77-1086TR) Avail: NTIS HC A03/MF A01 CSCL 07/4

The objective of this chapter is to review recent work in which high resolution dye lasers have been used to study a variety of interacting molecular systems cooled to near 0 K in a supersonic molecular beam. Beyond relating what are believed to be interesting results for these specific molecules, the intention is to illustrate the general advantage of coming supersonic beam and laser technology. Supersonic beams provide an intense source of molecules traveling in a vacuum with an extremely narrow velocity distribution, completely isolated from other particles, and cooled to such an extent that the excited rotational and vibrational levels of the molecules are almost completely depopulated. Current high resolution dye lasers are well suited to take advantage of the unique properties of a supersonic beam. For most allowed electronic transitions, sufficient laser intensity is now available to excite with near unit probability all resonant molecules as they travel through the laser beam. After reviewing the present state of development of supersonic molecular beams the discussion is focused on the efficiency of laser excitation of supersonic beams and the use of fluorescence as a detector of laser excitation as well as a few other possible detection devices. A number of recent applications of supersonic molecular beam laser spectroscopy are reviewed. Three types of examples are: stable, chemically bound molecules, van der Waals molecules, and a new field, van der Waals photochemistry. The use of laser spectroscopy as a probe of the translational and internal energy distributions of molecules involved in a supersonic free jet expansion is discussed. GRA

N78-12409# Science Applications, Inc., Ann Arbor, Mich.
LINEWIDTH AND CHEMISTRY MODELING OF THE HCl-H2 NON-REACTING MIXING LASER SYSTEM Final Report, Apr. 1976 - Apr. 1977
Frederick G. Smith and Robert E. Meredith 15 Aug. 1977 130 p refs
(Contract DAAK40-76-C-0754)
(AD-A044625; SAI-77-003-AA) Avail: NTIS HC A07/MF A01 CSCL 20/5

The linewidth and Einstein coefficient values required for modeling the HCl non-reacting mixing laser (NRML) have been reviewed and new linewidth calculations prepared. The results have been fit to a simple functional form suitable for inclusion in detailed laser modeling codes. Further development was also carried out of an efficient non-equilibrium chemistry subroutine suitable for inclusion in laser modeling codes. Listings of the detailed results and the chemistry code are given in appendices of the report. Author (GRA)

N78-12410# Ballistic Research Labs., Aberdeen Proving Ground, Md.
APPLICATION OF LASER PROBING TO BALLISTIC METEOROLOGY
Jad H. Batteh Aug. 1977 36 p refs
(DA Proj. 1T1-61101-A-91A)
(AD-A044560; BRL-2007) Avail: NTIS HC A03/MF A01 CSCL 04/2

Laser probing of the atmosphere is reviewed with particular emphasis on its application to ballistic meteorology. The requirements of the meteorological system are discussed, and the shortcomings of the rawinsonde technique, currently used, are outlined. A brief description of the relevant interactions of laser radiation with the atmosphere is presented. The potential of laser probing techniques for atmospheric measurements, as well as their current limitations, are then discussed in some detail. It is concluded that a system based on remote sensing with lasers is capable of timely and accurate measurements of all the relevant meteorological variables. However, present systems are unable to attain the maximum range required for ballistic applications. Author (GRA)

N78-12411# National Bureau of Standards, Washington, D. C.
OPTICAL MATERIALS CHARACTERIZATION Semiannual Technical Report, 1 Feb. - 31 Jul. 1977
Albert Feldman, Deane Horowitz, Roy M. Waxler, Marilyn J. Dodge, and Warren K. Gladden Aug. 1977 43 p refs
(ARPA Order 2620)
(AD-A045095; NBSIR-77-1304) Avail: NTIS HC A03/MF A01 CSCL 20/5

The refractive index of fusion cast CaF2 was measured at room temperature over the wavelength range 0.2144 micrometers to 8.662 micrometers and the data were fitted to a Selmeier type equation. Measurements of refractive index of hot forged CaF2 were extended to the wavelength range 0.2024 micrometers to 0.2483 micrometers. Data are presented for dn/dT of single crystal specimens of CaF2, BaF2, reactive atmosphere processed (RAP) KC1 and KBr, LiF, NaF, and 2SrF2, and polycrystalline chemical vapor deposited (CVD) ZnSe and ZnS. The measurements were done by the method of Fizeau interferometry over the temperature range -180 deg to 200 C at the wavelengths 0.6328 micrometers, 1.15 micrometers, 3.39 micrometers and 10.6 micrometers. Data are presented for the refractive indices, the linear thermal expansion and dn/dT of Lexan and Plexiglas 55. Author (GRA)

N78-12412# United Technologies Research Center, East Hartford, Conn.
ANALYSIS OF THE FACTORS CAUSING GLOW COLLAPSE IN HIGH ENERGY ELECTRON BEAM SUSTAINED CO LASERS Final Report, 1 Jan. - 31 Dec. 1976
William L. Nighan, Walter J. Wiegand, Robert J. Hall, and Robert H. Bullis Jul. 1977 58 p refs
(Contract F33615-76-C-2046)
(AD-A045215; UTRC/R77-922295-5) Avail: NTIS HC A04/MF A01 CSCL 20/5

In this investigation the causes of thermal instability in high power CO laser discharges were examined. This analysis showed that externally sustained CO laser discharges are inherently unstable, having instability-growth times on the order of 0.1 msec. The single most important factor affecting instability growth at a specific power density level was found to be electron-positive ion recombination. Changes in the recombination process as a consequence of positive ion kinetics were found to result in order of magnitude variations in instability growth. Because of the importance of recombination the effects of ion clustering reactions and water-ion chemistry are discussed in detail. Author (GRA)

N78-12413# Smithsonian Astrophysical Observatory, Cambridge, Mass.
COOPERATIVE LASER RANGING RESEARCH PROGRAM Final Report, 1 Nov. 1973 - 30 Apr. 1977
Michael R. Pearlman Hanscom AFB, Mass. AFGL May 1977 23 p
(Contract F19628-73-C-0089)
(AD-A044770; AFGL-TR-77-0140) Avail: NTIS HC A02/MF A01 CSCL 03/1

A lunar laser ranging facility was established at Orroral Valley, Australia by the Australian Division of National Mapping with the assistance of the Smithsonian Astrophysical Observatory with equipment obtained from the Air Force Geophysics Laboratory. Range measurements to lunar reflectors are made from this facility regularly. Some equipment problems must still be overcome before this observatory becomes fully operational. Author (GRA)

N78-12414# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
RESISTANCE OF DIELECTRIC COATINGS OF LEAD OXIDE AND CRYOLITE TO LASER RADIATION
N. L. Kramarenko, Yu. V. Naboykin, and Yu. A. Tiunov 16 Nov. 1976 11 p refs Transl. into ENGLISH from Kvantovaya Elektron. Tr. Resp. Seminara (Kiev), no. 3, 1969 p 311-313
(AD-A044669; FTD-ID(RS)I-1600-76) Avail: NTIS HC A02/MF A01 CSCL 20/5

Alternating layers of lead oxide and cryolite in a vacuum were used to obtain multilayer mirrors, which were applied as reflectors in a laser resonator. Resistance of these coatings to ruby laser radiation depending on the method of their preparation and the number of deposited layers was investigated. GRA

N78-12415# Avco-Everett Research Lab., Everett, Mass.
SCALABLE NANOSECOND CO2 LASER TECHNOLOGY Bi-monthly Progress Report, 7 Nov. 1976 - 7 Jan. 1977
Feb. 1977 51 p refs
(Contract EY-76-02-C-4055)
(COO-4055-1; BM-PR-2) Avail: NTIS HC A04/MF A01

Small signal absorption measurements over the 9 and 10 micron bands were carried out on various molecules to determine their potential as gain isolators. Saturation and relaxation experiments are being set up to further evaluate some of these absorber media. Theoretical studies are providing the necessary inputs in various molecules. Flowing saturable absorber device, the flow field structure of gain and absorber regions, was studied. A species concentration probe is being built to determine the amount of contamination of the gain medium by saturable absorber medium due to mass diffusion in the mixing layer. Nanosecond CO2 oscillator to conduct saturation experiments of candidate saturable absorber media under both single and multi-line conditions was also considered. ERA

37 MECHANICAL ENGINEERING

Includes auxiliary systems (non-power); machine elements and processes; and mechanical equipment.

N78-12416*# National Aeronautics and Space Administration, Washington, D. C.
DYNAMICS OF DISCONNECTABLE MICRODRIVES OF MINE HOISTING UNITS
D. P. Pampura and A. K. Maslix Nov. 1977 14 p refs Transl. into ENGLISH from Izu. Uyssh. Ucheb. Zaved., Elektromekh. (USSR), no. 9, Sep. 1969 p 1002-1007 Transl. by Kanner (Leo) Associates, Redwood City, Calif.
(Contract NASw-2790)
(NASA-TM-75186) Avail: NTIS HC A02/MF A01 CSCL 13I

A model study is presented of drives for the electromagnetic clutches used in hoists. Equations are set up and solved, describing the principles of the slip variation during the transient period of the plate engagement. Author

N78-12417*# Kanner (Leo) Associates, Redwood City, Calif.
HYBRID PROPULSION SYSTEM WITH A GYRO COMPONENT FOR ECONOMIC AND DYNAMIC OPERATION
B. Giera, J. Helling, and J. Schreck Nov. 1977 26 p refs Transl. into ENGLISH from Elektrtech. Z., A (West Germ.), v. 94, no. 11, Nov. 1973 p 653-660 Transl. by Kanner (Leo) Associates, Redwood City, Calif. Original doc. prep. by Inst. for Automotive Techniques
(Contract NASw-2790)
(NASA-TM-75188) Avail: NTIS HC A03/MF A01 CSCL 13I

The design of a hybrid drive with gyro components is described and its drive components for a medium class private car are discussed. The gyro component affects the short-period output

of the drive by accelerating and slowing down and -- because of the mechanical transfer of kinetic energy between the gyro and the vehicle -- it affects also the energy balance in the case of intermittent operation. Energy can be taken in as desired either in the form of fuel or as fuel and current. A high energy recovery efficiency as well as the favorable operating range of the interval combustion engine makes it possible to reduce the fuel consumption per unit distance travelled to almost half that for a private car with a traditional engine. Author

N78-12418*# National Aeronautics and Space Administration, Washington, D. C.
HYBRID DRIVE FOR MOTOR VEHICLES WITH A PREPONDERANTLY INTERMITTENT METHOD OF OPERATION
H. Schreck Dec. 1977 22 p refs Transl. into ENGLISH from Hybridantrieb fuer Kraftfahrzeuge mit Vorwiegend Instationaerer Betriebsweise, 3rd Status Seminar on Motor Vehicle and Traffic Eng. (Cologne-Poll) 1975 17 p Presented at the 3rd Status Seminar on Motor Vehicle and Traffic Eng., Cologne-Poll, 25-26 Nov. 1975 Transl. by Kanner (Leo) Associates, Redwood City, Calif. Original doc. prep. by Technische Hochschule, Aachen
(Contract NASw-2790)
(NASA-TM-75215) Avail: NTIS HC A02/MF A01 CSCL 13I

A flywheel hybrid propulsion system is compared with a conventional propulsion system in a test vehicle under intermittent operation. An energy balance is presented for the conventional propulsion system. Results so far indicate especially high energy conversion of the gyro component under dynamic operation along with favorable internal combustion engine conditions. Author

N78-12419*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
EVALUATION OF COAL FEED SYSTEMS BEING DEVELOPED BY THE ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION
R. L. Phen, W. Luckow, L. Mattson, D. Otth, and P. Tsou Sep. 1977 146 p refs Sponsored in part by ERDA
(Contract NAS7-100)
(NASA-CR-155267; JPL-Pub-77-54) Avail: NTIS HC A07/MF A01 CSCL 13I

Development criteria and recommendations for coal feed system selections that include supporting data are presented. Considered are the areas of coal feed coasts, coal feed system reliability, and the interaction of the feed system with the conversion process. Author

N78-12420# Mechanical Technology, Inc., Latham, N. Y.
RESEARCH PROGRAM ON COMPONENTS FOR CLOSED CYCLE GAS TURBINE PROPULSION MACHINERY Final Report, 17 May - 17 Aug. 1976
Thomas J. Ivsan 9 Sep. 1977 78 p refs
(Contract N00014-76-C-0553)
(AD-A044626; MTI-77TR77) Avail: NTIS HC A05/MF A01 CSCL 21/5

This report presents the results of a component research program for a closed cycle gas turbine powerplant. The report encompasses a first year effort on a test and analysis project evaluating axial-flow compressor performance in a helium gas environment and evaluating helium gas film bearings for a closed cycle gas turbine powerplant. Author (GRA)

N78-12421# Westinghouse Electric Corp., Pittsburgh, Pa. Advanced Energy Systems Div.
COMPACT CLOSED CYCLE BRAYTON SYSTEM FEASIBILITY STUDY Final Report, 20 May 1976 - 19 Jun. 1977
R. E. Thompson, G. H. Parker, R. L. Ammon, F. Spurrier, and B. L. Pierce Jul. 1977 437 p refs
(Contract N00014-76-C-0706)
(AD-A044413; WAES-TNR-233) Avail: NTIS HC A19/MF A01 CSCL 21/5

This report presents the feasibility of a closed Brayton cycle power conversion system for compact light weight naval propulsion plants. Reference case requirements have been established, including a unit output of 70,000 horsepower, turbine inlet gas temperature of 1700 F, and use of helium as the working fluid. Critical components such as bearings and compact heat exchangers have been evaluated and shown to have more than one suitable design solution. The cross-counterflow tubular type of heat exchanger was selected for the design concept precooler and intercooler. The tube and shell type of heat exchanger was selected for the recuperator. Gas bearings were selected for inclusion in the design concept. Preliminary designs of the most critical portion of the turbomachinery rotor, the first stage turbine, have been derived. Material tests have provided data which are important to this study and also have provided significant extensions to the data available to the materials community. An initial design concept has been defined for an integrated power conversion system which has the necessary characteristics and is appropriate for the most stringent requirements associated with the various energy sources, fossil or nuclear, which the Navy could desire to use. GRA

N78-12422# Air Force Systems Command, Wright-Patterson AFB, Ohio.
FRICTION WELDED CONFIGURATIONS FOR CONSTRUCTION
S. Buchholz 29 Dec. 1976 16 p refs Transl. into ENGLISH from Schweisstechnik (East Germany), v. 24, no. 11, Nov. 1974 p 509-512
(AD-A044673; FTD-ID(RS)I-1724-76) Avail: NTIS HC A02/MF A01 CSCL 13/8

Definite criteria of configuration are to be observed by engineers and technicians for the use of friction welding in the manufacture of structures suitable for friction welding, with the required strength properties and the exigencies of economical accomplishment. The authors have assembled for this purpose a large number of recommendations for the user resulting from the studies for industry carried out in the past, and from basic investigations. GRA

N78-12423# Oak Ridge Y-12 Plant, Tenn.
IMPROVED TECHNOLOGY FOR CERAMIC ENGINE COMPONENTS Progress Report, period ending Aug. 1976
W. E. Steinkamp and H. P. Wayland 27 Dec. 1976 23 p refs Revised
(Contract W-7405-eng-26)
(Y-DA-6874-Rev-1) Avail: NTIS HC A02/MF A01

To increase the efficiency of power turbines, vehicular turbines, and other combustion engines, higher operating temperatures are required. More refractory materials will be necessary for components in the resulting hostile thermal, physical, and chemical environments. Two ceramic materials, silicon nitride and silicon carbide, are currently candidates for such components. Optimum properties are obtained only when these compounds are fabricated to full density. Pressure sintering, or hot pressing, is necessary for full densification. Both the dense nitride and carbide of silicon are very hard and must be machined by diamond grinding; consequently, manufactured articles could be very expensive. Techniques capable of producing dense hardware near to finish size and contour while maintaining desirable material properties were developed. ERA

N78-12424# Energy Research and Development Administration, Washington, D. C. Div. of Transportation Energy Conservation.
ASSESSMENT OF THE TECHNOLOGY OF RANKINE ENGINES FOR AUTOMOBILES
Stephen Luchter and R. A. Renner Apr. 1977 96 p
(ERDA-77-54) Avail: NTIS HC A05/MF A01

The section on the state of the art in 1970 describes where the technology was prior to the government development program. The section describing the program initiated within the Environmental Protection Agency and concluded by the Energy Research and Development Administration presents an overview of the components and systems. A third section describes the work done during this same period by other government agencies and by private developers. Finally, the state of the art as it exists today is presented. The major conclusions are that the Rankine engine can provide very low emissions, that the fuel economy is not competitive with spark-ignition or projected alternative engines at this time, and that there is some evidence that a variety of fuels could be easily utilized in Rankine engines. ERA

N78-12425# General Electric Co., Schenectady, N. Y. Gas Turbine Div.

DEVELOPMENT OF HIGH TEMPERATURE TURBINE SUBSYSTEM TECHNOLOGY TO TECHNOLOGY READINESS STATUS; PHASE 1 Quarterly Report, Jun. - Sep. 1976
A. Caruvana 10 Nov. 1976 340 p refs
(Contract EX-76-C-01-1806)
(FE-1806-6) Avail: NTIS HC A15/MF A01

The requirements of overall plant design descriptions for combined cycle plants utilizing coal derived low Btu fuel gas and coal derived liquid fuel resulted in evaluations of various coal gasification processes including fixed bed and entrained bed. An advanced fixed bed concept was selected which operates at a very low steam to air ratio, achieves a cleaner more tar free operation and utilizes the coal fines mixed with tar. The Foster-Wheeler entrained bed system offers a high throughput with a savings in equipment costs. The availability of an efficient high temperature gas cleanup system would make the system attractive. The Benfield System was selected following evaluation of low temperature gas cleanup systems. Various design concepts are presented which represent the current status of various turbine configurations utilizing different blading cooling concepts. ERA

N78-12426# Advisory Group for Aerospace Research and Development, Paris (France).
A CATALOGUE OF CURRENT IMPACT DEVICES: A WORKING GROUP REPORT
D. H. Glaister, ed. Sep. 1977 60 p refs
(AGARD-R-658; ISBN-92-835-1256-1) Avail: NTIS HC A04/MF A01 CSCL 13I

The standardization of biodynamic impact testing was studied with special reference to seats and harnesses. This report is based on replies to questionnaires sent to research laboratories, and catalogues 52 impact test devices. They are listed according to the operating organizations, and classified by principle of operation (accelerators, decelerators, horizontal, vertical etc). Details of construction, performance and use of each facility are given. Also described are some current standards for crash impact testing and the principles of operation of the more common types of test devices. Author

38 QUALITY ASSURANCE AND RELIABILITY

Includes product sampling procedures and techniques; and quality control.

N78-12427 Washington Univ., St. Louis, Mo.
COMPUTER CONTROL OF MATERIALS TESTING MACHINES Ph.D. Thesis
Paul Floyd Woolverton 1976 191 p
Avail: Univ. Microfilms Order No. 77-16736

Improved methods of controlling materials test machines were developed and tested. In some materials testing, the material stiffness is a factor in the control loop. The loop must be tuned to account for this stiffness. The stiffness may change during testing and the loop should be retuned to compensate for the stiffness change. In multivariable testing the variables may be coupled so that changes in one variable interact with other variables. With present methods of control, the controller is tuned for optimum control based on one set of material properties. When the properties change the tuning is no longer optimum. In multivariable testing, decoupling of interaction is not done except for the Poisson ratio effect. Digital computer control of materials testing machines was investigated in three areas: control algorithms, automatic gain compensation, and decoupled two-variable control. The materials testing machine is set in stroke control and tuned for optimum stroke action. The digital control loop is a second, outer loop in which the primary variable of interest is controlled. Dissert. Abstr.

N78-12428# Aeronautical Research Labs., Melbourne (Australia).
CONFIDENCE LIMITS FOR SYSTEM RELIABILITY
P. F. Preston May 1976 43 p refs
(ARL/Sys-Rept-7) Copyrignt. Avail: Issuing Activity

The statistical problem of constructing confidence limits for system reliability from pass-fail data on the components is discussed. Usually such data are obtained from fixed sample size tests on the components. Exact and approximate methods for dealing with series systems are reviewed. A new approximate method is proposed and its performance evaluated in a number of special cases. An alternative approach that avoids some of the problems inherent in the above methods is to use variable sample size testing of the components. A sequential experimental design that is applicable to any coherent structure is given. Author

N78-12429# Illinois Univ., Urbana-Champaign. Dept. of Civil Engineering.
EFFECTS OF LACK-OF-PENETRATION AND LACK-OF-FUSION ON THE FATIGUE PROPERTIES OF 5083 ALUMINUM ALLOY WELDS Final Report
J. D. Burk and F. V. Lawrence, Jr. Jul. 1977 70 p refs
(Contract N00024-75-C-4504)
(AD-A044858) Avail: NTIS HC A04/MF A01 CSCL 13/5

The influence of weld defects on the mechanical properties of constructional grade aluminum alloy weldments has been the subject of considerable recent interest. The influence of distributed porosity on the tensile and fatigue properties of 5083 (and 6061) alloy weldments has been recently investigated by the authors. In the fatigue study, defects other than the weld toe and/or distributed porosity (most notable lack-of-fusion) were often found to result in substantially lower fatigue lives than would be expected from sound, as-welded test pieces. Consequently, internal, planar, weld-defects such as lack-of-fusion (LOF) or incomplete joint penetration (lack-of-penetration - LOP) must be considered potentially serious defects from the point of view of fatigue resistance. GRA

N78-12430# Missouri Univ., Columbia. Dept. of Statistics.
RELIABILITY THEORY AND STOCHASTIC PROCESSES. SUMMARY OF WORK ACCOMPLISHED Final Report, 1 May 1976 - 30 Jun. 1977
Douglas R. Miller 28 Sep. 1977 3 p refs
(Contract N00014-76-C-0843)
(AD-A044853) Avail: NTIS HC A02/MF A01 CSCL 14/4

Work related to reliability theory and stochastic processes accomplished under this ONR contract is summarized with reference given to technical reports prepared. Author (GRA)

N78-12431# Oklahoma State Univ., Stillwater. Fluid Power Research Center.
THE SURVIVABILITY CHARACTERISTICS OF FLUID POWER COMPONENTS IN CONTAMINATED ENVIRONMENTS Annual Report, 1 Jul. 1975 - 30 Jun. 1976
Dec. 1976 89 p
(Contract N00014-75-C-1157)
(AD-A045116; OSU-FPRC-6N1) Avail: NTIS HC A05/MF A01 CSCL 11/8

Contaminant wear in fluid power components has long been recognized as a major factor which influences the life and reliability of hydraulic systems. Ignoring catastrophic type failures, contaminant wear of hydraulic components is characterized by a gradual but persistent degradation in external performance. Author (GRA)

39 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; and thermal stress.

For applications see *05 Aircraft Design, Testing and Performance* and *18 Spacecraft Design, Testing and Performance*.

N78-12432 Purdue Univ., Lafayette, Ind.
MINIMUM WEIGHT DESIGN OF CYLINDRICAL SHELL WITH MULTIPLE STIFFENER SIZES UNDER BUCKLING CONSTRAINTS Ph.D. Thesis
Kazuo Kunoo 1976 134 p
Avail: Univ. Microfilms Order No. 77-15433

The buckling equations for the orthogonally stiffened cylindrical shell subjected to uniform axial compression and external pressure with classical simply-supported boundary

conditions are formulated by treating the stiffeners as discrete elements. For the case that all the stringers and rings are identical and equally spaced, the buckling equations are uncoupled into several sets of simpler and manageable equations according to their associated mode shapes. A method to calculate the minimum eigenvalue for a large general eigenvalue problem, the Ritz iteration method with Chebyshev procedure, is developed and its accuracies are evaluated. Dissert. Abstr.

N78-12433 Kentucky Univ., Lexington.
INFLUENCE OF MATERIAL PARAMETERS ON THE TENSIL INSTABILITY OF SHEET STEEL Ph.D. Thesis
Mahmoud Yehia Demeri 1976 188 p
Avail: Univ. Microfilms Order No. 77-15942

The influence of material parameters on the initiation and development of tensile instability in two materials which represent a wide range in stretch forming capacity, was investigated. The material parameters considered are the plastic strain ratio, the strain hardening exponent, the strain rate sensitivity parameter and a specimen strain rate parameter. The effects of strain, temperature and strain rate on the material parameters and their subsequent influence on the tensile instability strain were investigated using the grid analysis technique. An equation for instability strain based on the assumption that the stress is a function of strain, temperature and strain rate was developed in terms of easily measured parameters. At slow strain rates the deformation is assumed isothermal; this eliminates one variable from the equation and simplifies it. Good agreement was obtained between direct measurements on the specimen with that predicted by the equation developed and employing the derived material parameters. Dissert. Abstr.

N78-12434 California Univ., Berkeley.
ANALYSIS AND DESIGN OF NUMERICAL INTEGRATION METHODS IN STRUCTURAL DYNAMICS Ph.D. Thesis
Hans Martin Hilber 1976 111 p
Avail: Univ. Microfilms Order No. 77-15718

The algorithms introduced first are derived from the Newmark formulas by adding step-size-dependent viscous damping terms in the discrete equations of motion. The analysis reveals that the artificial viscosity of these schemes is not effectively filtering out undesirable high frequency modes. In fact, it is shown that the qualitative behavior of artificial and real viscous damping terms is essentially the same, inasmuch as both are practically ineffective in high frequency modes. Based on this experience a one-parameter family of algorithms is developed. The new methods have commensurate storage and computational efforts when compared with Newmark and Wilson methods. Dissert. Abstr.

N78-12435 California Univ., Berkeley.
SEISMIC RESPONSE OF AXISYMMETRIC SOIL-STRUCTURE Ph.D. Thesis
Ernst Berger 1976 189 p
Avail: Univ. Microfilms Order No. 77-15607

The accuracy of seismic response computations made with two-dimensional finite element methods of analysis applied to three dimensional soil structure systems is investigated. The three dimensional soil structure system is modeled by an axisymmetric finite element model while the equivalent two-dimensional system is represented by a plane strain model. A finite element computer code ALUSH is developed which computes the seismic response of axisymmetric soil-structure systems subjected to horizontal, vertical and rotational earthquake input motions. The nonlinear stress-strain behavior of soil masses subjected to strong earthquake motions and the frequency independent nature of the damping characteristics of soils are considered in the method of analysis by use of the equivalent linear method and the complex response method, respectively. Dissert. Abstr.

N78-12436 California Univ., Berkeley.
INVESTIGATION OF THE INELASTIC CHARACTERISTICS OF A STEEL FRAME USING SYSTEM IDENTIFICATION AND SHAKING TABLE EXPERIMENTS Ph.D. Thesis
Vernon Charles Matzen 1976 127 p
Avail: Univ. Microfilms Order No. 77-15782

A realistic nonlinear mathematical model is formulated to represent the seismic behavior of a single story steel structure. With this model and the parameters established for it, the energy absorbing characteristics of the structure are investigated. The mathematical development of system identification involves the formulation of a second order nonlinear differential equation with linear viscous damping and Ramberg-Osgood type hysteresis. To integrate the equation an iterative routine that uses linear acceleration and a residual load correction is developed. An integral squared error function is used to evaluate the goodness of fit between the model's response and the structure's response when both are subjected to the same excitation. Shaking table experiments in which a single story steel frame was subjected to several earthquake excitations were designed to give specific information about the structure: how its behavior depends on the particular excitation, and how the previous loading history affects its subsequent behavior. Dissert. Abstr.

N78-12437 Ohio State Univ., Columbus.
A REDUCED INTEGRATION TECHNIQUE FOR IMPROVED ACCURACY OF FINITE ELEMENT APPROXIMATIONS Ph.D. Thesis
Kamar Jit Singh 1977 106 p
Avail: Univ. Microfilms Order No. 77-17137

A concept of covering is introduced which explains the basis of obtaining the best stiffness matrix to use. Only the least number of deformation modes required are retained. Whereas, the other investigators avoided the reduction of stiffness matrix into a singular form, the proposed method has no such restriction and use is made of the singular matrix to obtain the solution. The new method is based on a new concept that the load vector is composed of two parts. The first part is covered by the reduced stiffness matrix corresponding to the constant strain state which is essential for the convergence. The second part is the one which is covered by the unreduced stiffness matrix. Therefore, the displacement solution is also in two parts given by the reduced and the unreduced stiffness matrices. The solution thus obtained is the best for that refinement as it is unhampered by the singularity requirement. In contrast, the other methods move away from the correct solution as they avoid the singular stiffness matrix and introduce multiple covering. The proposed method uses a four-point isoparametric element with one-point integration. Dissert. Abstr.

N78-12438 Iowa State Univ. of Science and Technology, Ames.
OPTIMIZATION OF BONDED JOINTS BY FINITE ELEMENT AND PHOTOELASTICITY Ph.D. Thesis
Vachara Thongcharoen 1977 114 p
Avail: Univ. Microfilms Order No. 77-16980

The improvement of stress distributions in both single and double lap joints was investigated. Factors contributing to the stress distributions were determined as the overlap length of the joint, the thickness of the joint, and the adherend to adhesive modulus of elasticity ratio. A relatively uniform shear stress distribution was obtained with appropriate values of the mentioned factors. This led to an optimization concept which indicated overlap lengths of single and double lap joints to be 1.25+ and 2+ respectively. The modulus ratio was determined as 7 plus in order to obtain a uniform shear stress distribution. Optimum joint thickness was not obtained. Dissert. Abstr.

N78-12439 Rochester Univ., N. Y.
SOME INTERACTIONS BETWEEN MICROSTRUCTURAL DEFECTS Ph.D. Thesis
Hsiang-Yung Yu 1977 148 p
Avail: Univ. Microfilms Order No. 77-16260

An analysis and a numerical computer program were developed for calculating the punch velocity in the impression creep test of an axisymmetric body in the dislocation creep region. The method of solution is an extension of the direct stiffness method. The body is replaced by a system of finite ring elements of triangular cross sections interconnected along circumferential nodal circles. The equations of equilibrium for the body are derived from the principle of minimum potential energy. The creep behavior of the body is obtained by the use of Prandtl-Reuss equations together with Von Mises yield functions and an incremental approach. The procedure starts with the elastic solution of the problem and then calculates the creep strains for a small time increment including the nodal displacements under the punch. These creep strains are treated as initial strains

to determine the new stress distribution at the end of the time increment. Dissert. Abstr.

N78-12440 Ohio State Univ., Columbus.
VIBRATION OF COMPLEX STRUCTURES BY MATCHING SPATIALLY DEPENDENT BOUNDARY CONDITIONS OF CLASSICAL SOLUTIONS: SPECIFICALLY VIBRATION CHARACTERISTICS OF HOLLOW SYMMETRICAL BLADES BASED ON THIN SHELL THEORY Ph.D. Thesis
Ahmed Mohammad Al-Jumaily 1977 230 p
Avail: Univ. Microfilms Order No. 77-17072

The mathematical formulation and solution methods for dynamics problems of continuous structures composed of beam, plate, and shell elements are investigated by developing and using the Matching of Continuous Boundary Conditions Technique. This technique results in a closed form functional solution for the resonant frequencies and corresponding mode shapes of the composite structure. A hollow symmetrical turbomachinery blade is used to illustrate the general method. The blade is composed of two co-linear open profile circular cylindrical shell elements connected at their straight edges. Experimental investigations are performed to support the results of the theories. Dissert. Abstr.

N78-12441 Engineering Sciences Data Unit, London (England).
FATIGUE STRENGTH OF TRANSVERSE BUTT WELDS IN STEEL PLATE UNDER AXIAL LOADING
Jun. 1977 9 p
(ESDU-77011; ISBN-0-85679-182-2) For information on availability of series, sub-series and other individual data items, write NTIS, Attn: ESDU, Springfield, Va. 22161. HC $132.00

Data on the as-welded fatigue strength of transverse butt welds in steel plate under axial loading is provided. The joints were manufactured from plates between 6 mm and 50 mm thick prepared prior to welding with either square, single or double V or U weld preparation and welded from both sides. (Sealing runs were used in the case of single V or U weld preparation). The welding methods employed were either submerged arc welding or arc welding with flux covered electrodes. Root runs were backchipped except where backchipping was purposely incomplete to produce specific defect types and sizes which may arise from poor welding techniques that can occur in ordinary production. ERA

N78-12442*# Old Dominion Univ., Norfolk, Va.
MODAL IDENTIFICATION OF STRUCTURES FROM THE RESPONSES AND RANDOM DECREMENT SIGNATURES Final Report
Sam R. Brahim and G. L. Goglia Oct. 1977 52 p refs
(Grant NsG-1325)
(NASA-CR-155321) Avail: NTIS HC A04/MF A01 CSCL 20K

The theory and application of a method which utilizes the free response of a structure to determine its vibration parameters are described. The time-domain free response is digitized and used in a digital computer program to determine the number of modes excited, the natural frequencies, the damping factors, and the modal vectors. The technique is applied to a complex generalized payload model previously tested using sine sweep method and analyzed by NASTRAN. Ten modes of the payload model are identified. In case free decay response is not readily available, an algorithm is developed to obtain the free responses of a structure from its random responses, due to some unknown or known random input or inputs, using the random decrement technique without changing time correlation between signals. The algorithm is tested using random responses from a generalized payload model and from the space shuttle model. Author

N78-12443*# National Aeronautics and Space Administration, Washington, D. C.
SIXTH NASTRAN USERS' COLLOQUIUM
Oct. 1977 473 p refs Colloq. held at Cleveland, 4-6 Oct. 1977
(NASA-CP-2018; E-9303) Avail: NTIS HC A20/MF A01 CSCL 20K

Papers are presented on NASTRAN programming, and substructuring methods, as well as on fluids and thermal applications. Specific applications and capabilities of NASTRAN were also delineated along with general auxiliary programs. For individual titles, see N78-12444 through N78-12472.

N78-12444*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
NASTRAN: STATUS, PLANS, AND PERFORMANCE
Deene J. Weidman *In its* Sixth NASTRAN Users' Colloq. 1977 p ix-xviii refs (For availability see N78-12443 03-39)
Avail: NTIS HC A20/MF A01 CSCL 20K

Plans for NASTRAN, a program developed and improved over the past 13 years, were outlined in reference to a new capability of level 17. The target release date is given as December 1977 and domestic release will be through COSMIC. As an example of the improved efficiency of NASTRAN level 16, a table of CPU run time comparisons is shown. Author

N78-12445*# Universal Analytics, Inc., Playa Del Rey, Calif.
A 3-D HYDROELASTIC ANALYSIS IN NASTRAN WITH GENERAL FLUID AND STRUCTURE GEOMETRY
D. N. Herting, R. L. Hoesly, and D. L. Herendeen *In* NASA, Washington Sixth NASTRAN Users' Colloq. 1977 p 3-23 refs (For availability see N78-12443 03-39)
Avail: NTIS HC A20/MF A01 CSCL 20K

The implementation of a general three dimensional hydroelastic mode analysis capability in NASTRAN is presented. Finite elements with polyhedral shapes define the fluid; existing NASTRAN plate elements define the fluid/structure interface. Efficient solution methods were implemented to allow a separate structural matrix reduction and to allow connection of the fluid mass directly to a small set of grid points or modal coordinates representing the structure. Test case results for the various solution options are presented. Author

N78-12446*# Naval Ship Research and Development Center, Bethesda, Md.
FINITE ELEMENT SOLUTIONS OF FREE SURFACE FLOWS
P. Richard Zarda and Melvyn S. Marcus *In* NASA, Washington Sixth NASTRAN Users' Colloq. 1977 p 27-52 refs (For availability see N78-12443 03-39)
Avail: NTIS HC A20/MF A01 CSCL 20K

A procedure is presented for using NASTRAN to determine the flow field about arbitrarily shaped bodies in the presence of a free surface. The fundamental unknown of the problem is the velocity potential which must satisfy Laplace's equation in the fluid region. Boundary conditions on the free surface may involve second order derivatives in space and time. In cases involving infinite domains either a tractable radiation condition is applied at a truncated boundary or a series expansion is used and matched to the local finite elements. Solutions are presented for harmonic, transient, and steady state problems and compared to either exact solutions or other numerical solutions. Author

N78-12447*# Computer Sciences Corp., Los Angeles, Calif.
MODIFYING THE NASTRAN SYSTEM WITH A NEW CAPABILITY
John R. McDonough *In* NASA, Washington Sixth NASTRAN Users' Colloq. 1977 p 53-64 refs (For availability see N78-12443 03-39)
Avail: NTIS HC A20/MF A01 CSCL 20K

The need for a new capability/maintenance interface specification for the NASTRAN system was discussed. Those problems are highlighted which are most difficult to resolve when a new capability is delivered for inclusion into an archive level. The guidelines presented show the objectives of new capability integration as they relate to design and development, delivery, checkout, and documentation. Examples of new capability/maintenance interface already done on an informal basis are presented to illustrate the 'test conditions' of the idea of defining implementation objectives. Author

N78-12448*# Northrop Corp., Beverly Hills, Calif. NASTRAN Utilization Improvement Program.
NORCK: A NASTRAN MODULE TO CHECK INPUT DATA AND ELEMENT GEOMETRY
David T. Zemer *In* NASA, Washington Sixth NASTRAN Users'

Colloq. 1977 p 65-74 (For availability see N78-12443 03-39)
Avail: NTIS HC A20/MF A01 CSCL 20K

NORCK, a direct matrix abstraction module, was written which allows the user the ability to define error limits for finite element geometry and properties within the solution flow, and to find these errors before the more expensive parts of the analysis are run. Author

N78-12449*# Computer Sciences Corp., Los Angeles, Calif.
STUDY OF THE NASTRAN INPUT/OUTPUT SYSTEMS
W. K. Brown and W. F. Schoellmann *In* NASA, Washington Sixth NASTRAN Users' Colloq. 1977 p 75-91 refs (For availability see N78-12443 03-39)
Avail: NTIS HC A20/MF A01 CSCL 20K

The basic characteristics of the NASTRAN level 16 I/O subsystem are presented with particular reference to blocking/deblocking aspects, I/O methods used on the IBM, CDC, and UNIVAC machines, definition of basic NASTRAN I/O control tables, and portability of parts of the I/O subsystem to other programs outside the NASTRAN environment. An explanation of the IBM primary, secondary, and tertiary files defined by the data definition (DD) cards in the NASTRAN JCL procedure is included. The explanation is intended to enlighten users as to the purpose of these DD cards, how they relate to one another, and why there are no similar type definition cards required on the CDC and UNIVAC versions. Enhancements designed to increase overall efficiency and decrease core requirements are also recommended. Author

N78-12450*# Lockheed-California Co., Burbank.
STRUCTURAL MODEL INTEGRITY
D. V. Wallerstein, R. S. Lahey, and G. W. Haggenmacher *In* NASA, Washington Sixth NASTRAN Users' Colloq. 1977 p 93-104 (For availability see N78-12443 03-39)
Avail: NTIS HC A20/MF A01 CSCL 20K

Many of the practical aspects and problems of ensuring the integrity of a structural model are discussed, as well as the steps which have been taken in the NASTRAN system to assure that these checks can be routinely performed. Model integrity as used applies not only to the structural model but also to the loads applied to the model. Emphasis is also placed on the fact that when dealing with substructure analysis, all of the checking procedures discussed should be applied at the lowest level of substructure prior to any coupling. Author

N78-12451*# Northrop Corp., Beverly Hills, Calif. NASTRAN Utilization Improvement Program.
A DIRECT MATRIX ABSTRACTION PROCEDURE FOR A STATIC SOLUTION DURING A PHASE 1 SUBSTRUCTURING ANALYSIS
David T. Zemer *In* NASA, Washington Sixth NASTRAN Users' Colloq. 1977 p 105-117 refs (For availability see N78-12443 03-39)
Avail: NTIS HC A02/MF A01 CSCL 20K

A directed matrix abstraction procedure is described which allows a static solution to be obtained in phase 1 of a three phase NASTRAN substructuring analysis while at the same time storing all information needed to complete the substructuring analysis. Author

N78-12452*# Fairchild Space and Electronics Co., Germantown, Md.
A NASTRAN DMAP ALTER FOR THE COUPLING OF MODAL AND PHYSICAL COORDINATE SUBSTRUCTURES
Thomas L. Wilson *In* NASA, Washington Sixth NASTRAN Users' Colloq. 1977 p 119-130 refs (For availability see N78-12443 03-39)
Avail: NTIS HC A20/MF A01 CSCL 20K

A method is described to derive a generalized coordinate model consisting of flexible cantilever modes and rigid body modes from a physical coordinate model using a direct matrix abstraction procedure alter to rigid format 3. This model can readily be coupled to other substructures using modal synthesis techniques. It allows the use of a reduced size model for structural analyses while maintaining the capability of recovering the accelerations, forces, stresses, etc., from the original, large, complex model. This output recovery is accomplished with the use of a loads transformation matrix which relates the output parameters to the modal coordinate accelerations. In addition, a method is described to synthesize structural models consisting of hybrid coordinates for use in dynamic response analyses where one structure is described using physical coordinates and the other using generalized modal coordinates. Author

N78-12453*# Sperry Rand Corp., New York.
AUTOMATED MULTI-LEVEL SUBSTRUCTURING FOR SPERRY'S VERSION OF NASTRAN
Gordan C. Chan and Ronald P. Schmitz *In* NASA, Washington Sixth NASTRAN User's Colloq. 1977 p 133-154 refs (For availability see N78-12443 03-39)
Avail: NTIS HC A20/MF A01 CSCL 20K

Automated multilevel substructuring was successfully implemented in the Sperry version of NASTRAN. The development was achieved with a minimum effort; only seven modules and fourteen new routines were added. Approximately forty subroutines were modified and four new user cards added to NASTRAN. Significant features of the new capability include: multilevel substructuring; up to 128 superelements; up to 456 boundary grid points per superelement; up to 9 user superelement files, each with multi-reel or disc option; and data storage for one or more superelements per user file. Author

N78-12454*# Universal Analytics, Inc., Los Angeles, Calif.
UNEXPECTED DIVIDENDS FROM LEVEL 16 AUTOMATED SUBSTRUCTURING
Eric I. Field *In* NASA, Washington Sixth NASTRAN Users' Colloq. 1977 p 155-160 refs (For availability see N78-12443 03-39)
Avail: NTIS HC A20/MF A01 CSCL 20K

The automated multistage substructuring capability now available in NASTRAN level 16 is shown to provide a number of unexpected tools for use in both project planning and the structural design cycle. The payoffs in terms of improved design, more reliable results, and confidence are extra benefits added to the savings in cost and schedule that can be realized. To realize these advantages, some old stereotypical assumptions of what substructuring entails must be challenged. Author

N78-12455*# Lockheed-California Co., Burbank.
SUBSTRUCTURE COUPLING: A DIFFERENT APPROACH
R. S. Lahey *In* NASA, Washington Sixth NASTRAN Users' Colloq. 1977 p 161-173 refs (For availability see N78-12443 03-39)
Avail: NTIS HC A20/MF A01 CSCL 20K

The substructure analysis of the Lockheed L-1011 Dash 500 long range derivative without use of the NASTRAN level 16 multisage substructuring capability is described. It is presented as an example of how a large structural analysis can be organized into manageable independent tasks and how preprocessors, model definition conventions, and data management programs can be used to simplify the data management and model documentation. A procedure is described to analyze a single substructure by modifying the static solution to solve the interface compatibility equations simultaneously with the substructure solution. Author

N78-12456*# Naval Underwater Systems Center, Newport, R. I.
ANALYSIS OF MAGNETIC FIELDS USING VARIATIONAL PRINCIPLES AND CELAS2 ELEMENTS
John W. Frye and Rolf G. Kasper *In* NASA, Washington Sixth NASTRAN Users' Colloq. 1977 p 175-192 refs (For availability see N78-12443 03-39)
Avail: NTIS HC A20/MF A01 CSCL 20K

Prospective techniques for analyzing magnetic fields using NASTRAN are reviewed. A variational principle utilizing a vector potential function is presented which has as its Euler equations the required field equations and boundary conditions for static magnetic fields including current sources. The need for an addition to this variational principle of a constraint condition is discussed. Some results using the Lagrange multiplier method to apply the constraint and CELAS2 elements to simulate the matrices are given. Practical considerations of using large numbers of CELAS2 elements are discussed. Author

N78-12457*# International Business Machines Corp., Armonk, N.Y. System Products Div.

APPLICATION OF SYMBOLIC/NUMERIC MATRIX SOLUTION TECHNIQUES TO THE NASTRAN PROGRAM
E. M. Buturla and S. H. Burroughs *In* NASA, Washington Sixth NASTRAN Users' Colloq. 1977 p 193-198 refs (For availability see N78-12443 03-39)
Avail: NTIS HC A20/MF A01 CSCL 20K

The matrix solving algorithm of any finite element algorithm is extremely important since solution of the matrix equations requires a large amount of elapse time due to null calculations and excessive input/output operations. An alternate method of solving the matrix equations is presented. A symbolic processing step followed by numeric solution yields the solution very rapidly and is especially useful for nonlinear problems. Author

N78-12458*# IBM Federal Systems Div., Owego, N. Y.
ALTERNATE APPROACHES TO VIBRATION AND SHOCK ANALYSIS USING NASTRAN
Richard E. Denver and Joseph M. Menichello *In* NASA, Washington Sixth NASTRAN Users' Colloq. 1977 p 199-212 refs (For availability see N78-12443 03-39)
Avail: NTIS HC A20/MF A01 CSCL 20K

A method that derives an approximate equivalent static load to a base excitation shock analysis is described. The transient analysis in the current level of NASTRAN, level 16, does not directly provide for either input acceleration forcing functions or enforced boundary displacement. In the suggested alternate analysis format, equivalent force input functions are applied to the constrained locations by using the artifice of placing a large mass, with respect to the total system mass, at the desired acceleration input points. This shortcut static analysis approach is presented to approximate the expensive and time consuming dynamics analysis approach to the base excitation shock analysis. Author

N78-12459*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
NASTRAN USE FOR CYCLIC RESPONSE AND FATIGUE ANALYSIS OF WIND TURBINE TOWERS
C. C. Chamis, P. Manos, J. H. Sinclair, and J. R. Winemiller *In its* Sixth NASTRAN Users' Colloq. 1977 p 213-233 refs (For availability see N78-12443 03-39)
(Contract E(49-26)-1004)
Avail: NTIS HC A20/MF A01 CSCL 20K

A procedure is described which uses NASTRAN coupled with fatigue criteria via a postprocessor to determine the cyclic response and to assess the fatigue resistance (fatigue life) of wind turbine generator towers. The cyclic loads to which the tower may be subjected are entered either in a quasi-static approach though static load subcases (Rigid Format 1) or through the direct dynamic response (Rigid Format 9) features of NASTRAN. The fatigue criteria are applied to NASTRAN output data from either rigid format through an externally written user program embedded in a postprocessor. Author

N78-12460*# Naval Ship Research and Development Center, Bethesda, Md.
NEW LARGE DEFLECTION ANALYSIS FOR NASTRAN
Myles M. Hurwitz *In* NASA, Washington Sixth NASTRAN Users' Colloq. 1977 p 235-255 refs (For availability see N78-12443 03-39)
Avail: NTIS HC A20/MF A01 CSCL 20K

A large deflection analysis was developed for NASTRAN level 16 as an alternative to Rigid Format 4. A progress report is presented for a long term, general nonlinear analysis NASTRAN project, which contains (1) the theory of the structural analysis and numerical analysis methods presently used, and (2) some simple test problems comparing the new analysis with Rigid Format 4. Author

N78-12461*# Watervliet Arsenal, N.Y.
SINGULAR PLASTIC ELEMENT: NASTRAN IMPLEMENTATION AND APPLICATION
M. A. Hussain, S. L. Pu, and W. E. Lorensen *In* NASA, Washington Sixth NASTRAN Users' Colloq. 1977 p 257-273 refs (For availability see N78-12443 03-39)
Avail: NTIS HC A20/MF A01 CSCL 20K

The elastic and plastic singularities near a crack tip are obtained from higher order isoparametric elements. This is simply accomplished by collapsing the quadrilateral element into the triangular element and by judicious choice of adjacent mid-side nodes. Specifically for the cubic element the elastic singularity is obtained by placing the mid-side nodes adjacent to the crack tip at 1/9th and 4/9th locations. The plastic singularity is constructed using the sliding node concept. These elements have been implemented in NASTRAN as user dummy elements. Author

N78-12462*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
APPLICATION OF THE TRPLT1 ELEMENT TO LARGE AMPLITUDE FREE VIBRATIONS OF PLATES
Chu Mei (Vought Corp., Hampton, Va.) and James L. Rogers, Jr. *In its* Sixth NASTRAN Users' Colloq. 1977 p 275-298 refs (For availability see N78-12443 03-39)
Avail: NTIS HC A20/MF A01 CSCL 20K

A finite element formulation is developed for analyzing large amplitude free flexural vibrations of thin plates in NASTRAN. Stress distributions in the plate, in addition to deflection shapes and nonlinear frequencies are determined. Linearized equations of motion governing large amplitude oscillations of plates and a linearized geometrical stiffness matrix are presented. The solution procedure and convergence characteristics are discussed. The quasi-linear geometrical stiffness matrix for an eighteen degree-of-freedom higher order triangular plate element is evaluated by using a seven-point numerical integration. Nonlinear frequencies for square, rectangular, rhombic, and isosceles triangular plates, with edges simply supported or clamped, are compared with earlier solutions. The present formulation is found to give results entirely adequate for engineering purposes. Author

N78-12463*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
A CONDENSED FORM OF NASTRAN
James L. Rogers, Jr. (Vought Corp.), Chu Mei, and W. Keith Brown (Computer Sci. Corp.) *In its* Sixth NASTRAN Users' Colloq. 1977 p 299-325 refs (For availability see N78-12443 03-39)
Avail: NTIS HC A20/MF A01 CSCL 20K

The Interactive Graphics Finite Element System, IGFES, is described along with its supporting analysis software, graphics terminal support package and hardware configurations. IGFES provides an interactive design tool for structural engineers via pre- and postprocessing of finite element data. The system currently runs on an IBM 360/44 OS-MFT system or a PDP 11/40 DOS/BATCH system. Graphics devices are supported using an inhouse developed, device independent terminal support package. Support is available for the Calcomp 563 drum plotter, Tektronix 4002A storage display terminal and the Lundy Electronics 20 inch standalone refresh display system. IGFES and its associated systems are written in FORTRAN IV. Author

N78-12464*# Tektronix, Inc., Beaverton, Oreg.
A STAND-ALONE INTERACTIVE GRAPHICS FINITE ELEMENT MODELING SYSTEM
Jeffrey Z. Gingerich, Marv M. Abe, Randall L. Vinecore, Gary J. Romans, and Barry M. Ratihn *In* NASA, Washington Sixth NASTRAN Users' Colloq. 1977 p 327-340 (For availability see N78-12443 03-39)
Avail: NTIS HC A20/MF A01 CSCL 20K

The finite element modeling (FEM) system described here is an interactive graphics system designed for use with an intelligent terminal. It offers an economical alternative to the conventional methods (hand compilation and remote terminals) of 2 and 3-dimensional model generation. Using local computing and local storage, this FEM system allows the operator to create and display 3-dimensional models entirely off-line from the host computer. This eliminates costly on-line computer and host-processing time, and makes the user more effective by greatly reducing computer response time. The system allows model generation by down-loading node and element data from the host computer or by using the system's model generation operations for digitizing and automatic creation. The system then generates completed model information in the desired analysis package's bulk data format and transmits it to the host computer for finite element analysis. Author

N78-12465*# Israel Aircraft Industries Ltd., Lod.
RINA: AN INTERACTIVE SYSTEM FOR THE RAPID INTERPRETATION OF NASTRAN RESULTS
A. I. Raibstone and A. Pipano *In* NASA, Washington Sixth NASTRAN Users' Colloq. 1977 p 341-355 refs (For availability see N78-12443 03-39)
Avail: NTIS HC A20/MF A01 CSCL 20K

RINA is a general post-processor system which performs data reduction, post processing and post analysis of NASTRAN results. RINA can be run in either batch or time-sharing mode. The system, which is an expansion of the NASDAT program, performs the following tasks: (1) scan of extreme values for displacements, forces, stresses and margins of safety, (2) computations of envelopes for displacements, forces, stresses and margins of safety, (3) computations of allowables and margins of safety; and (4) generation of NASTRAN tables needed for reanalysis computations. Usage of all these options provides the analyst with an efficient tool for the study and interpretation of NASTRAN analysis results and their presentation for project documentation. Author

N78-12466*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
SOFTWARE FOR TRANSFERRING NASTRAN DATA-BLOCKS BETWEEN DISSIMILAR COMPUTERS
Richard Rosencranz, James L. Rogers, Jr., and Reg S. Mitchell *In its* Sixth NASTRAN Users' Colloq. 1977 p 357-368 refs (For availability see N78-12443 03-39)
Avail: NTIS HC A20/MF A01 CSCL 20K

Efforts to freely exchange all types of NASTRAN datablocks between the internalized forms in any of three makes of NASTRAN-class computers and that of any other such make are described. The medium used is magnetic tape formatted in BCD (Binary Coded Decimal) character and numerical fields. The method used involves a FORTRAN-coded post-processor and a pre-processor, mostly portable but with a small assembly-coded component peculiar to each make of machine. Snags in a method reported in an earlier NASTRAN colloquium have been overcome and functional rerquirements upgraded as well. Author

N78-12467# Watervliet Arsenal, N.Y.
FINITE ELEMENT ANALYSIS OF FIBER WRAPPED SHELLS WITH NON-SYMMETRIC LOADS
G. Peter OHara *In* NASA, Washington Sixth NASTRAN Users Colloq. 1977 p 369-381 refs (For availability see N78-12443 03-39)
Avail: NTIS HC A20/MF A01 CSCL 20K

The structural analysis of filament wound composite shells presents several rather large problems; the composite material properties are anisotropic, the properties vary along the length of the shell, the profile may be very complex, the thickness may vary along the length of the shell, more than one fiber type may be used, an isotropic liner may be used, large non-symmetric loads may be present, etc. Though all of these things tend to make the finite element method very attractive, the data preparation is rather large. The paper describes two FORTRAN IV programs to aid in the preparation of the important grid and material information. Also, some examples of the application of these programs is presented. Author

N78-12468*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
NASTRAN FINITE ELEMENT IDEALIZATION STUDY
W. R. Case and J. B. Mason *In its* Sixth NASTRAN Users' Colloq. 1977 p 383-403 refs (For availability see N78-12443 03-39)
Avail: NTIS HC A20/MF A01 CSCL 20K

The investigation of the effects of variations of mesh refinement and mesh pattern were conducted using a basic rectangular mesh pattern. When employing the constant strain TRMEM element, the basic rectangular pattern was subdivided into triangles. This subdivision employs two different triangular patterns and allows results to be obtained which demonstrate the effect of modelling bias. Errors in tip deflection, direct stress, and shearing stress as a function of mesh size and element aspect ratio were obtained as well as mid-span stress distributions. All problems were solved on an IBM 360/95 computer using MacNeal-Schwendler Version MSC-38 Rigid Format-1 of the NASTRAN computer program. While NASTRAN uses double precision arithmetic for the solution of the global equations for displacements, subsequent computations to obtain element stresses are carried out in single precision. This suggests that some improvement in stress recovery might be expected when using the higher precision DCD machines. Author

N78-12469*# Virginia Univ., Charlottesville.
STRESS ANALYSIS OF PRESSURE VESSEL ASSEMBLY
Richard T. Eppink, Furman W. Barton, and Lawrence H. Gilligan *In* NASA, Washington Sixth NASTRAN Users' Colloq. 1977 p 405-417 Sponsored in part by Navy (For availability see N78-12443 03-39)
Avail: NTIS HC A20/MF A01 CSCL 20K

A radome assembly capable of withstanding large hydrostatic pressures was designed with a sapphire hemisperical dome and a plastic housing. These two parts were connected with a stainless steel flange ring. A finite-element stress analysis of this assembly was accomplished and an experimental load test was performed to verify the predicted stresses. Author

N78-12470*# Prototype Development Associates, Inc., Santa Ana, Calif.
AN AUTOMATED DATA GENERATOR FOR NASTRAN
Edward L. Stanton *In* NASA, Washington Sixth NASTRAN Users' Colloq. 1977 p 419-434 refs (For availability see N78-12443 03-39)
Avail: NTIS HC A20/MF A01 CSCL 20K

A modeling system based on construction-in-context of geometry and physical properties data is adapted for NASTRAN finite element data generation. This system was originally developed for generating three-dimensional finite data for composite structures in PATCHES-III using parametric cubic models. These finite line, surface and volume models constructed using simple data directives will be subdivided into NASTRAN finite elements and their supporting data in the new data generator. Any geometry can be constructed as illustrated by a compressor fan blade with camber, twist and changing airfoil section and the shape then subdivided using a uniform or non-uniform mesh. Special emphasis is given to the adaption of construction-in-context to composite material property modeling. A PMAT series of directives is described for any one, two or three-dimensionally reinforced composite that allows the phase properties, as well as composite properties, to be generated. Author

N78-12471*# Universal Analytics, Inc., Playa Del Rey, Calif.
DEVELOPMENT OF AN AUTOMATED MULTI-STAGE MODAL SYNTHESIS SYSTEM FOR NASTRAN
D. N. Herting and R. L. Hoesly *In* NASA, Washington Sixth NASTRAN Users' Colloq. 1977 p 435-448 refs (For availability see N78-12443 03-39)
Avail: NTIS HC A20/MF A01 CSCL 20K

A mode synthesis development to be scheduled in the NASTRAN multi-level substructuring system for general dynamics applications is described. The method combines the better features of several state of the art mode synthesis techniques, yet is general enough to provide for any arbitrary combination of boundary degrees of freedom and normal mode boundary conditions. Normal modes or complex eigenvectors may be used in the definition of a structure component which may be combined with other components of any type. Combination structures fabricated from component modes may be processed as normal substructures, including further multi-stage mode synthesis reductions. Included are discussions of the user control of the system and advantages in actual application. Author

N78-12472*# Computer Sciences Corp., Hampton, Va.
ADDITION OF RIGID ELEMENTS TO NASTRAN
P. R. Pamidi and J. D. Ronkhite (Bell Helicopter Textron) *In* NASA, Washington Sixth NASTRAN Users' Colloq. 1977 p 449-468 refs (For availability see N78-12443 03-39)
Avail: NTIS HC A20/MF A01 CSCL 20K

Four rigid elements, namely, a rigid rod element (CRIGDR) and three rigid body elements (CRIGD1, GRIGD2 and CRIGD3), have recently been added to NASTRAN and will be available in the next public release of the program. The theoretical formulation, the bulk data information and the programming details pertaining to these elements are presented. Also, the use of these elements in practical and realistic problems is illustrated by employing them in the solution of two helicopter structural analysis problems. Author

N78-12473# Toronto Univ. (Ontario). Inst. for Aerospace Studies.

BUCKLING OF IMPERFECT ANISOTROPIC CYLINDERS UNDER COMBINED LOADING

M. Booton Aug. 1976 173 p refs
(UTIAS-203; ISSN-0082-5255) Avail: NTIS HC A08/MF A01

The buckling of circular cylinders under the simultaneous action of torsion, external pressure and axial compression is considered. Homogeneous isotropic and (laminated) anisotropic behavior was analyzed, as was the effect of small axisymmetric geometric imperfections. The theoretical analysis, which takes into account the exact form of the boundary conditions and nonlinear prebuckling deformations, resulted in approximate interaction formulas for buckling under these three load conditions. Experimental work involved buckling of four shell models, two of which were homogeneous isotropic, the others being laminated glass/epoxy composite cylinders. Test data were then compared with interaction formulas. Finally, design criteria are proposed. Author

N78-12474 California Univ., Berkeley.

EARTHQUAKE RESPONSE OF COUPLED SHEAR WALL BUILDINGS Ph.D. Thesis

Thirawat Srichatrapimuk 1976 122 p
Avail: Univ. Microfilms Order No. 77-15866

An efficient analytical technique for determining linear and nonlinear response of coupled shear wall structures is developed. Walls are assumed to be nonyielding with all inelastic action confined to coupling beams. Structural displacements are represented as a linear combination of the first few natural mode shapes in both lateral and longitudinal vibration of individual walls which are treated as independent cantilevers. The analytical technique is implemented in earthquake response analyses of two coupled shear wall systems; analytical results are then correlated with observations of earthquake damage in these structures. The earthquake response of coupled shear walls is then interpreted, and design considerations for efficient earthquake resistant shear wall systems are suggested. Dissert. Abstr.

N78-12475*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

EFFECT OF END-RING STIFFNESS ON BUCKLING OF PRESSURE-LOADED STIFFENED CONICAL SHELLS

Randall C. Davis and Jerry G. Williams Washington Dec. 1977 33 p refs
(NASA-TP-1079; L-11915) Avail: NTIS HC A03/MF A01 CSCL 20K

Buckling studies were conducted on truncated 120 deg conical shells having large end rings and many interior reinforcing rings that are typical of aeroshells used as spacecraft decelerators. Changes in base-end-ring stiffness were accomplished by simply machining away a portion of the base ring between successive buckling tests. Initial imperfection measurements from the test cones were included in the analytical model. Author

N78-12476# Lehigh Univ., Bethlehem, Pa. Inst. of Fracture and Solid Mechanics.

MECHANICS OF DUCTILE FRACTURE

G. C. Sih Jun. 1977 27 p refs
(Contract N00014-76-C-0094)
(AD-A043909; IFSM-77-78) Avail: NTIS HC A03/MF A01 CSCL 20/11

The phenomenon of ductile fracture in plate specimens is described by a finite element stress analysis coupled with the strain energy density fracture criterion. The last ligament of failure tends to curve developing a cup-and-cone type of fracture in tensile bars and sheer lips in plate specimens. Three-dimensional crack growth profiles are developed by assuming that materials tend to break along the path of minimum strain energy density whose critical value is characteristic of the material and has been measured experimentally for both elastic and plastic materials. The results are encouraging in that ductile fracture behavior can be modeled by holding the strain energy density constant. Hence, allowable load and net section size can be predicted for specimens that deform in the plastic range. Author (GRA)

N78-12477# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

TRANSITION PROCESSES DURING COMPRESSION OF CYLINDRICAL SHELLS IN A STRONG MAGNETIC FIELD

V. T. Mikhkelsoo and A. B. Novgorodtsev 3 Jan. 1977 21 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedeniy Energ. (USSR), no. 10, 1970 p 19-24
(AD-A044699; FTD-ID(RS)I-1874-76) Avail: NTIS HC A02/MF A01 CSCL 20/3

A calculated arrangement has been worked out for compression of thin-walled metallic shells in the field of a single-turn solenoid, taking into account penetration of the field into the shell, its heating up by vortex currents, redistribution of current over the surface of the solenoid, and the presence of a matching transformer in the discharge loop. The accepted inertial model of deformation is applicable with beta greater than 0.2. At smaller values the influence of the forces of resistance to deformation are significant. The most important factors which determine the efficiency of acceleration in the arrangement which is considered are the active resistance and inductance of the primary circuit, and also the fact that part of the current of the solenoid flows on the ends of the solenoid and do not participate in the creation of the working field. GRA

N78-12478# Missouri Univ., Columbia. Dept. of Statistics.

ESTIMATE OF RELIABILITY IN THE STRESS-STRENGTH MODEL Interim Report

Asit P. Basu 1977 17 p refs Presented at 26th Conf. on the Design of Experiments in Army Research Development and Testing
(Grants AF-AFOSR-2795-75; DAA29-76-G-0301)
(AD-A044730; AFOSR-77-1193TR; ARB-77-2) Avail: NTIS HC A02/MF A01 CSCL 14/4

Suppose Y is the strength of a component which is subject to a stress X. Then the component fails whenever $X = \text{or} > y$, and there is no failure when $X < Y$. In this paper the problem of estimating the reliability function $R = P(X < Y)$ is considered. A survey of available results is presented and some new results are considered. Author (GRA)

N78-12479# Douglas Aircraft Co., Inc., Long Beach, Calif.

THE DETERMINATION OF DEFLECTION AND STRESS DISTRIBUTION FOR A TRANSPARENT LAMINATED BEAM Final Report, Jan. 1976 - Mar. 1977

Paul H. Denke and Joseph B. Hoffman Nov. 1976 174 p refs
(Contract F33615-75-C-3105)
(AD-A044595; MDC-J7173; AFFDL-TR-76-114) Avail: NTIS HC A08/MF A01 CSCL 01/3

This report documents the theory and procedures for calculating the elastic deflection and stress distribution of a flat, laminated beam with fixed ends or simply-supported ends comprised of transparency materials subjected to a normal point load at the midpoint of the beam. The development of a computer program using the basic theory is presented along with illustrative examples and a 'user's manual.' The program results have been favorably compared with actual test data and with a finite element method. Author (GRA)

N78-12480# Lehigh Univ., Bethlehem, Pa. Center for the Application of Mathematics.

MATERIAL STABILITY AND BIFURCATION IN FINITE ELASTICITY

K. N. Sawyers Aug. 1977 52 p refs
(Contract N00014-76-C-0235)
(AD-A045052; CAM-100-29) Avail: NTIS HC A04/MF A01 CSCL 20/11

The theory of small superposed deformation for isotropic incompressible elastic materials is used to obtain necessary restriction on the form of the strain-energy function by requiring that the speed of propagation be real for waves that pass through a finitely deformed body of material (i.e., Hadamard stability criterion), and to determine critical loading conditions for a thick rectangular plate under which bifurcation solutions (i.e., adjacent equilibrium positions) can exist. The possibility of bifurcation under

tensile loading, when one pair of faces of a plate are force free, is precluded by further material stability considerations.
Author (GRA)

N78-12481# Army Engineer Waterways Experiment Station, Vicksburg, Miss.
GENERAL DEFORMATION (ELASTIC AND INELASTIC) AND STRESS DISTRIBUTION THEORY IN SOILS Final Report
Richard H. Ledbetter Sep. 1977 124 p refs
(DA Proj. 4A1-61101-A-91D)
(AD-A045022; WES-TR-S-77-10) Avail: NTIS HC A06/MF A01 CSCL 08/13

A nonstrain-hardening general deformation theory that describes both elastic and inelastic behavior of soils, whether unbound or asphalt-bound, was developed. The theory circumvents the need for yield surfaces or yield stresses separating elastic and inelastic behavior, and it defines elastic plus inelastic behavior as they naturally and simultaneously occur. Soil behavior is unified by the theory being applicable to both cohesive and cohesionless soils. The theory is applicable to soils whether in a pavement structure or beneath a foundation and is applicable for static, moving, and vibratory loadings. Laboratory testing can establish the model and be directly applied to field behavior and vice versa. Soil stress distributions for field loading conditions can be derived from properties and requirements of the theory. Response to moving wheel loads for distributed and mixed traffic on a pavement structure can be completely simulated in laboratory tests based on the theory. Continuation of this research is being sponsored by the Department of Transportation, Transportation Systems Center. Author (GRA)

N78-12482# California Univ., Los Angeles. School of Engineering and Applied Science.
FUNDAMENTALS OF THE STATISTICAL THEORY OF FRACTURE
S. B. Batdorf Jul. 1977 33 p refs Sponsored in part by the AF
(Contract N00014-76-C-0445)
(AD-A044855; UCLA-ENG-7759) Avail: NTIS HC A03/MF A01 CSCL 20/11

The first important study of fracture statistics was that of Weibull. His work was based on the tacit assumption that only the component of stress normal to a crack plane contributes to its fracture, and on the use of simple analytical formulas for failure probability. Recent progress in short-term fracture includes the use of more refined fracture criteria and a search for better distribution functions for the frequency of cracks, based on microstructural considerations. Use of the critical value of strain energy release rate as a fracture criterion leads to improved agreement with experiment. Consideration is also given to the statistics of fracture in static fatigue and in dynamic fracture.
Author (GRA)

N78-12483# California Univ., Berkeley. Lawrence Berkeley Lab.
RESISTIVITY MODELING FOR ARBITRARILY SHAPED TWO DIMENSIONAL STRUCTURES. PART 1: THEORETICAL FORMULATION
A. Dey and H. F. Morrison Oct. 1976 19 p refs
(Contract W-7405-eng-48)
(LBL-5223) Avail: NTIS HC A02/MF A01

A numerical technique was developed to solve the three dimensional potential distribution about a point source of current located in or on the surface of a half-space containing arbitrary two dimensional conductivity distribution. Finite difference equations were obtained for Poisson's equations, making point as well as area discretization, of the subsurface. Potential distribution at all points in the set defining the half-space were simultaneously obtained for multiple point sources of current injection. The solution was derived with direct, explicit, matrix inversion techniques. An empirical mixed boundary condition was used at the infinitely distant edges of the lower half-space. Accurate solutions using area discretization method were obtained with significantly less attendant computational costs than with the relaxation, finite element of networks solution techniques, for models of comparable dimensions. ERA

N78-12484# California Univ., Berkeley. Lawrence Berkeley Lab.
RESISTIVITY MODELING FOR ARBITRARILY SHAPED TWO DIMENSIONAL STRUCTURES. PART 2: USER'S GUIDE TO THE FORTRAN ALGORITHM RESIS2D
A. Dey Oct. 1976 57 p
(Contract W-7405-eng-48)
(LBL-5283) Avail: NTIS HC A04/MF A01

The development of a numerical solution technique is described to obtain the potential distribution in three dimensional space due to a point source of charge injection in or on the surface of a half space containing any arbitrary two dimensional conductivity distribution. Finite difference approximations are made to discretize the governing Poisson's equation with appropriate boundary conditions. The discretization of Poisson's equation by elemental area brought about a numerical formulation for a more effective matrix technique to be utilized to solve the potential distribution at each node of a discretized half-space. A FORTRAN algorithm named RESIS2D was written to implement the generalized solution method. The FORTRAN program is described, in terms of its construction. The formal input and output parameters for the relevant subroutines are discussed. The program is designed to be implemented on a CDC 7600 machine. ERA

N78-12485# Sandia Labs., Albuquerque, N. Mex.
MEASUREMENT OF RESIDUAL STRESSES BY THE HOLE-DRILLING METHOD
W. R. Delameter and T. C. Mamaros Apr. 1977 27 p refs
(Contract EY-76-C-04-0789)
(SAND-77-8006) Avail: NTIS HC A02/MF A01

Recommendations for the gathering and reduction of data include some improvements in procedures in order to correct for variations in hole diameter and differences in the elastic constants of the material being tested compared to the established calibration constants relating measured strains to residual stresses. An analytical discussion concerning the two dimensional elastic solution to the problem of a hole disturbing a uniform state of stress is used to help explain the theory upon which the hole drilling technique is based, and a similar analysis is used to evaluate the magnitude of error introduced by local plasticity around the hole. ERA

42 GEOSCIENCES (GENERAL)

No abstracts in this category.

43 EARTH RESOURCES

Includes remote sensing of earth resources by aircraft and spacecraft; photogrammetry; and aerial photography.
For instrumentation see *35 Instrumentation and Photography*.

N78-12486 Catholic Univ. of America, Washington, D. C.
APPLICATION OF DIGITAL FILTERING TO SATELLITE GEODESY Ph.D. Thesis
Clyde Clarenton Goad 1977 85 p
Avail: Univ. Microfilms Order No. 77-16801

Accurate measurements of satellite orbits were used to deduce the value of the lunar semi-diurnal (M2) ocean tide. Since the ocean tides cause periodic perturbations with periods greater than a week in the evolution of the Keplerian elements of a satellite, the mean Keplerian elements (osculating Keplerian elements less all short period oscillations) are studied. Approximate analytical transformations were applied which account for large first-order effects. Elimination of very high frequency effects was accomplished with the aid of an ideal low-pass filter. Two terms in the harmonic expansion of the M2 global tide height can be observed. These estimates are somewhat smaller than recent publicized coefficients obtained from numerical solutions of

Laplace tidal equations. Using this value of M2 to calculate the deceleration of the lunar mean longitude yields an estimate in close agreement with recent analyses of ancient eclipses and modern transit data. Dissert. Abstr.

N78-12487 Ohio State Univ., Columbus.
ANALYSIS OF PHOTOGRAMMETRIC AERIAL CAMERA CALIBRATIONS Ph.D. Thesis
Wicha Jiwalai 1977 213 p
Avail: Univ. Microfilms Order No. 77-17103

A pair of reseau type aerial cameras were calibrated by using goniometer, collimator bank and stellar calibration methods. This information was applied to unconstrained exterior orientation, positional constraints, rotational constraints, and fully constrained exterior orientation. The calibration data provided significantly different results in all cases except single photo resection with no constraint on the exterior orientation. The results of block adjustment indicated the presence of some types of systematic errors. Moreover, they yielded such different results that it was not possible to group them together. Out of six calibrations, in block triangulations, only one provided satisfactory results on both planimetry and height while another one provided a satisfactory result only in planimetry. Dissert. Abstr.

N78-12488 Purdue Univ., Lafayette, Ind.
GEOMORPHOLOGY AND HYDROLOGY OF SELECTED MIDWESTERN STREAMS Ph.D. Thesis
Dorland Elmo Edgar 1976 408 p
Avail: Univ. Microfilms Order No. 77-15402

Field data were collected from 32 alluvial channel streams in Indiana, 17 in Illinois, and 12 in Kansas. Sites were selected near gaging stations with records of at least 10 years duration and minimum drainage areas of 15 sq mi. Streams with significant flow regulation or channel modifications were not included. Forty-nine variables were included to describe discharge variability, magnitude, frequency, and duration; cross-sectional and planimetric channel morphology; selected attributes of channel boundary alluvium, flow hydraulics, and certain basin characteristics for each stream. All data analyses were performed on the basic measurements and their common logarithms. Dissert. Abstr.

N78-12489 California Univ., Berkeley.
GEOMETRIC PROCESSING FOR DIGITAL MAPPING WITH MULTISERIES REMOTE SENSING DATA Ph.D. Thesis
Mitsuru Nasu 1976 198 p
Avail: Univ. Microfilms Order No. 77-15799

Digital geometric procedures for positioning multiseries remote sensing data have been studied for digital cartographic mapping purposes. Tests with simulated and real data show that the digital approach is feasible. Improvement of sensor exterior orientation by multistage geometric sampling and improved point identification by digital image matching result in higher positioning accuracy. Dissert. Abstr.

N78-12490 Old Dominion Univ., Norfolk, Va.
FUNDAMENTAL ANALYSIS OF THE LINEAR MULTIPLE REGRESSION TECHNIQUE FOR QUANTIFICATION OF WATER QUALITY PARAMETERS FROM REMOTE SENSING DATA Ph.D. Thesis
Charles Henry Whitlock, III 1977 184 p
Avail: Univ. Microfilms Order No. 77-16940

Optical physics and environmental conditions under which multiple regression analysis is applicable were defined. An investigation of signal response equations was conducted and concepts were tested by application to both analytical test cases and actual remote sensing data. Least squares and statistical concepts for performing the analysis were examined and a test for evaluating the applicability of least squares techniques to a particular set of data was defined. It was concluded that constituents with linear radiance gradients may be quantified from signals which contain nonlinear atmospheric and surface reflection effects for both homogeneous and nonhomogeneous water bodies, provided accurate data can be obtained and nonlinearities are constant with wavelength. Dissert. Abstr.

N78-12491 Purdue Univ., Lafayette, Ind.
IMAGE MODELING WITH APPLICATION TO MEASUREMENT Ph.D. Thesis
James William Burnett 1976 89 p
Avail: Univ. Microfilms Order No. 77-15386

A fast and efficient algorithm was developed for pulse width estimation from blurred and nonlinear observation in the presence of signal dependent noise. The problem is approached by modeling the signal (reflected light intensity) as a discrete position finite state Markov process. Sample functions of such a process are graphically represented by a path through a trellis. By assigning a cost or length to each branch of the trellis a MAP sequence estimate of the signal is computed by finding the minimum cost or minimum length path through the trellis. The Viterbi algorithm is introduced as an efficient means of finding the minimum cost path through the trellis. When the possible states are known a-priori, the algorithm is shown to produce asymptotically unbiased, minimum variance discrete width estimates. Computer simulation results show the variance of discrete estimates is close to the Cramer-Rao bound. Dissert. Abstr.

N78-12492*# Delaware Univ., Newark. Coll. of Marine Studies.
SKYLAB/EREP APPLICATION TO ECOLOGICAL,GEOLOGICAL AND OCEANOGRAPHIC INVESTIGATIONS OF DELAWARE BAY Final Report, Jun. 1973 - Mar. 1976
Vytautas Klemas, Principal Investigator, David S. Bartlett, William D. Philpot, Robert H. Rogers (Bendix Aerospace Systems Div., Ann Arbor, Mich.), and Larry E. Reed (Bendix Aerospace Systems Div., Ann Arbor, Mich.) May 1976 68 p refs Original contains imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls, S. D. EREP
(Contract NAS1-12304)
(E78-10003; NASA-CR-155207; CMS-NASA-1-76) Avail: NTIS HC A04/MF A01 CSCL 08C

The author has identified the following significant results. Skylab/EREP S190A and S190B film products were optically enhanced and visually interpreted to extract data suitable for mapping coastal land use; inventorying wetlands vegetation; monitoring tidal conditions; observing suspended sediment patterns; charting surface currents; locating coastal fronts and water mass boundaries; monitoring industrial and municipal waste dumps in the ocean; and determining the size and flow direction of river, bay, and man-made discharge plumes. Film products were visually analyzed to identify and map ten land use and vegetation categories at a scale of 1:125,000. Thematic maps were compared with CARETS land use maps, resulting in classification accuracies of 50 to 98%. Digital tapes from S192 were used to prepare thematic land use maps. The resolutions of the S190A, S190B, and S192 systems were 20-40m, 10-20m, and 70-100m, respectively.

N78-12493*# Geological Survey, Iowa City, Iowa. Research Div.
LAND CLASSIFICATION OF SOUTH-CENTRAL IOWA FROM COMPUTER ENHANCED IMAGES Progress Report, 3 Feb. - 3 Apr. 1976
James R. Lucas, Principal Investigator (Technicolor Graphic Services, Inc., Sioux Falls, South Dakota), James V. Taranik (EROS Data Center, Sioux Falls, South Dakota), and Frederic C. Billingsley (JPL) 3 May 1976 90 p refs Original contains color imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls, S. D. ERTS
(Contract NAS5-20832)
(E78-10005; NASA-CR-155209; PR-5) Avail: NTIS HC A05/MF A01 CSCL 08B

The author has identified the following significant results. The Iowa Geological Survey developed its own capability for producing color products from digitally enhanced LANDSAT data. Research showed that efficient production of enhanced images required full utilization of both computer and photographic enhancement procedures. The 29 August 1972 photo-optically enhanced color composite was more easily interpreted for land classification purposes than standard color composites.

N78-12494*# Geological Survey, Reston, Va.
PREPARATION OF A GEOLOGIC PHOTO MAP AND HYDROLOGIC STUDY OF THE YEMEN ARAB REPUBLIC Final Report
M. J. Grolier, Principal Investigator, W. C. Overstreet, G. C. Tibbitts, Jr., D. F. Davidson, and M. M. Ibrahim (Mineral and Petroleum

Authority, Yemen) 30 Sep. 1977 20 p refs ERTS
(NASA Order G-21990)
(E78-10008; NASA-CR-155212) Avail: NTIS HC A02/MF A01 CSCL 08H

There are no author-identified significant results in this report.

N78-12495*# International Business Machines Corp., Gaithersburg, Md.
RESAMPLING STUDY Final Report
D. G. Ferneyhough, Principal Investigator and C. W. Niblack Mar. 1977 175 p Original contains imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls, S. D. ERTS
(Contract NAS5-21865)
(E78-10014; NASA-CR-156643; FSD-7700-01) Avail: NTIS HC A08/MF A01 CSCL 05B

The author has identified the following significant results. The nearest neighbor and cubic convolution resampling algorithms were applied to a variety of images extracted from LANDSAT MSS data. A comparison of the results demonstrated that (1) cubic convolution can cause spreading of small features and can introduce noticeable overshoot (ringing) into the data; (2) cubic convolution attenuates the high spatial frequencies compared to the original and nearest neighbor resampled data; and (3) cubic convolution generally produces photographic products of superior visual quality. The effects of the resampling algorithms on multispectral classification were not conclusively determined due to the small number of images tested.

N78-12496*# Environmental Research Inst. of Michigan, Ann Arbor. Infrared and Optics Div.
AN EVALUATION OF THE SIGNATURE EXTENSION APPROACH TO LARGE AREA CROP INVENTORIES UTILIZING SPACE IMAGE DATA Final Technical Report, 15 May 1976 - 14 Nov. 1977
Richard F. Nalepka, Principal Investigator, Richard C. Cicone, John L. Stinson, and Ronald J. Balon Nov. 1977 117 p refs EREP
(Contract NAS9-14988)
(E78-10016; NASA-CR-151552; ERIM-122700-33-F) Avail: NTIS HC A06/MF A01 CSCL 02C

The author has identified the following significant results. Two examples of haze correction algorithms were tested: CROP-A and XSTAR. The CROP-A was tested in a unitemporal mode on data collected in 1973-74 over ten sample segments in Kansas. Because of the uniformly low level of haze present in these segments, no conclusion could be reached about CROP-A's ability to compensate for haze. It was noted, however, that in some cases CROP-A made serious errors which actually degraded classification performance. The haze correction algorithm XSTAR was tested in a multitemporal mode on 1975-76 LACIE sample segment data over 23 blind sites in Kansas and 18 sample segments in North Dakota, providing wide range of haze levels and other conditions for algorithm evaluation. It was found that this algorithm substantially improved signature extension classification accuracy when a sum-of-likelihoods classifier was used with an alien rejection threshold.

N78-12497*# Purdue Univ., Lafayette, Ind. Lab. for Applications of Remote Sensing.
COMPUTER-AIDED ANALYSIS OF LANDSAT DATA FOR SURVEYING TEXAS COASTAL ZONE ENVIRONMENTS
Stevan J. Kristof, Principal Investigator and Richard A. Weismiller 6 Sep. 1977 33 p refs Original contains imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls, S. D. EREP
(Contracts NAS9-14016; NAS9-14970)
(E78-10018; NASA-CR-151536; LARS-TR-090677) Avail: NTIS HC A03/MF A01 CSCL 08J

The author has identified the following significant results. The study areas were Pass Cavallo and Port O'Connor. The following terrestrial and aquatic environments were discriminated: alternating beach ridges, swales, sand dunes, beach birms, deflation surfaces, land-water interface, urban, spoil areas, fresh and salt water marshes, grass and woodland, recently burned or grazed areas, submerged vegetation, and waterways.

N78-12498*# Environmental Research Inst. of Michigan, Ann Arbor. Infrared and Optics Div.
EVALUATION OF SIGNATURE EXTENSION ALGORITHMS Interim Technical Report, 15 May 1976 - 31 Aug. 1977
R. F. Nalepka, Principal Investigator and Alex P. Pentland Sep. 1977 76 p refs EREP
(Contract NAS9-14988)
(E78-10021; NASA-CR-151537; ERIM-122700-29-T) Avail: NTIS HC A05/MF A01 CSCL 05B

The author has identified the following significant results. One of the major findings was that nearly all of the bias in the proportion estimates of the multisegment training and classification procedure resulted from the particular configuration of the signature set used for classification, rather than from peculiarities of the recognition sample segments. This meant that the proportion estimation bias could be accurately corrected simply by estimating the bias on the original six training segments. The bias corrected proportion estimates of the multisegment training and classification procedure were extremely accurate and had a low variance when compared to local training and classification. This finding may have important ramifications for reducing the cost and increasing the accuracy of bias correction procedures.

N78-12499*# Control Data Corp., Minneapolis, Minn.
DIGITAL IMAGE CORRELATION TECHNIQUES APPLIED TO LANDSAT MULTISPECTRAL IMAGERY
L. O. Bonrud, Principal Investigator and W. J. Miller Jan. 1976 118 p refs Original contains imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls, S. D. ERTS
(Contract NAS5-20570)
(E78-10022; NASA-CR-156647) Avail: NTIS HC A06/MF A01 CSCL 05B

The author has identified the following significant results. Automatic image registration and resampling techniques applied to LANDSAT data achieved accuracies, resulting in mean radial displacement errors of less than 0.2 pixel. The process method utilized recursive computational techniques and line-by-line updating on the basis of feedback error signals. Goodness of local feature matching was evaluated through the implementation of a correlation algorithm. An automatic restart allowed the system to derive control point coordinates over a portion of the image and to restart the process, utilizing this new control point information as initial estimates.

N78-12500*# National Marine Fisheries Service, Bay Saint Louis, Miss.
LANDSAT MENHADEN AND THREAD HERRING RESOURCES INVESTIGATION Final Report
Andrew J. Kemmerer, Principal Investigator, J. T. Brucks, J. A. Butler, K. H. Faller (NASA. National Space Technol. Labs., Miss.), H. J. Holley, T. D. Leming, K. J. Savastano, and T. M. Vanselous Oct. 1977 274 p refs Original contains color imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls, S. D. ERTS
(NASA Order S-54114)
(E78-10024; NASA-CR-155248; SEFC-Contrib-77-16; MARMAP-Contrib-145) Avail: NTIS HC A12/MF A01 CSCL 08A

The author has identified the following significant results. The relationship between the distribution of menhaden and selected oceanographic parameters (water color, turbidity, and possibly chlorophyll concentrations) was established. Similar relationships for thread herring were not established nor were relationships relating to the abundance of either species. Use of aircraft and LANDSAT remote sensing instruments to measure or infer a set of basic oceanographic parameters was evaluated. Parameters which could be accurately inferred included surface water temperature, salinity, and color. Water turbidity (Secchi disk) was evaluated as marginally inferrable from the LANDSAT MSS data and chlorophyll-a concentrations as less than marginal. These evaluations considered the parameters only as experienced in the two test areas using available sensors and statistical techniques.

N78-12501*# Department of Surveys and Lands, Gaborone (Botswana).

AN AID TO THE DEVELOPMENT OF BOTSWANA'S RESOURCES Quarterly Progress Report
J. A. Raffle, Principal Investigator Jan. 1977 7 p Sponsored by NASA ERTS
(E78-10025; NASA-CR-155249; QPR-4) Avail: NTIS HC A02/MF A01 CSCL 08F

There are no author-identified significant results in this report.

N78-12502*# Atomic Energy Commission, Dacca (Bangladesh).
INVESTIGATIONS USING DATA FROM LANDSAT-2 Quarterly Report, Jul. - Sep. 1977
Anwar Hossain, Principal Investigator Nov. 1977 4 p refs Sponsored by NASA ERTS
(E78-10026; NASA-CR-155251) Avail: NTIS HC A02/MF A01 CSCL 05B

The author has identified the following significant results. A land use map was prepared of Dacca-Narayanganj-Demra area on a scale of 1:50,000. LANDSAT imageries of Dinajpur and Rangpur districts were studied. The difference between the exposed Pleistocene red clay, this clay under alluvial cover, and recent alluvium was noted. Different types of soils, crops, etc. were delineated on the ERTS imagery.

N78-12503*# Geological Survey, Malaysia.
GEOLOGICAL AND HYDROGEOLOGICAL INVESTIGATIONS IN WEST MALAYSIA Technical Report, Apr. 1976 - Feb. 1977
Jaafar Bin Ahmad, Principal Investigator and Shu Yeoh Khoon Jun. 1977 30 p refs Sponsored by NASA Original contains color imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls, S. D. ERTS
(E78-10027; NASA-CR-155252; MP.KB/E/038/RS) Avail: NTIS HC A03/MF A01 CSCL 08G

The author has identified the following significant results. Large structures along the east coast of the peninsula were discovered. Of particular significance were the circular structures which were believed to be associated with mineralization and whose existence was unknown. The distribution of the younger sediments along the east coast appeared to be more widespread than previously indicated. Along the Pahang coast on the southern end, small traces of raised beach lines were noted up to six miles inland. The existence of these beach lines was unknown due to their isolation in large coastal swamps.

N78-12504*# Purdue Univ., Lafayette, Ind. Lab. for Applications of Remote Sensing.
A CASE STUDY USING ECHO(EXTRACTION AND CLASSIFICATION OF HOMOGENEOUS OBJECTS) FOR ANALYSIS OF MULTISPECTRAL SCANNER DATA
Donna Scholz, Principal Investigator, James Russell, John Lindenlaub, and Philip Swain 1 Sep. 1977 94 p refs Original contains imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls, S. D. EREP
(Contract NAS9-14970)
(E78-10030; NASA-CR-151532; LARS-Publ-090177) Avail: NTIS HC A05/MF A01 CSCL 05B

There are no author-identified significant results in this report.

N78-12505*# Tennessee Univ. Space Inst., Tullahoma. Remote Sensing Div.
APPLICATION OF LANDSAT IMAGES TO WETLAND STUDY AND LAND USE CLASSIFICATION IN WEST TENNESSEE, PART 1 Final Report
F. Shahrokhi, Principal Investigator and Nancy L. Jones [1977] 70 p refs Original contains imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls, S. D. ERTS
(Contract NAS8-31980)
(E78-10031; NASA-CR-150422) Avail: NTIS HC A04/MF A01 CSCL 08B

The author has identified the following significant results. Densiometric analysis was performed on LANDSAT data to permit numerical classification of objects observed in the imagery on the basis of measurements of optical density. Relative light transmission measurements were taken on four types of scene elements in each of three LANDSAT black and white bands in order to determine which classification could be distinguished. The analysis of band 6 determined forest and agricultural classifications, but not the urban and wetlands. Both bands 4 and 5 showed a significant difference existed between the confirmed classification of wetlands-agriculture, and urban areas. Therefore, the combination of band 6 with either 4 or 5 would permit the separation of the urban from the wetland classification. To enhance the urban and wetland boundaries, the LANDSAT black and white bands were combined in a multispectral additive color viewer. Several combinations of filters and light intensities were used to obtain maximum discrimination between points of interest. The best results for enhancing wetland boundaries and urban areas were achieved by using a color composite (a blue, green, and red filter on bands 4, 5 and 6 respectively).

N78-12506*# Tennessee Univ. Space Inst., Tullahoma. Remote Sensing Div.
THE APPLICATION OF LANDSAT-1 IMAGERY FOR MONITORING STRIP MINES IN THE NEW RIVER WATERSHED IN NORTHEAST TENNESSEE, PART 2 Final Report
F. Shahrokhi, Principal Investigator and Leslie A. Sharber [1977] 80 p refs Original contains imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls, S. D. ERTS
(Contract NAS8-31980)
(E78-10032; NASA-CR-150423) Avail: NTIS HC A05/MF A01 CSCL 08I

The author has identified the following significant results. LANDSAT imagery and supplementary aircraft photography of the New River drainage basin were subjected to a multilevel analysis using conventional photointerpretation methods, densitometric techniques, multispectral analysis, and statistical tests to determine the accuracy of LANDSAT-1 imagery for measuring strip mines of common size. The LANDSAT areas were compared with low altitude measurements. The average accuracy over all the mined land sample areas mapped from LANDSAT-1 was 90%. The discrimination of strip mine subcategories is somewhat limited on LANDSAT imagery. A mine site, whether active or inactive, can be inferred by lack of vegetation, by shape, or image texture. Mine ponds are difficult or impossible to detect because of their small size and turbidity. Unless bordered and contrasted with vegetation, haulage roads are impossible to delineate. Preparation plants and refuge areas are not detectable. Density slicing of LANDSAT band 7 proved most useful in the detection of reclamation progress within the mined areas. For most state requirements for year-round monitoring of surface mined land, LANDSAT is of limited value. However, for periodic updating of regional surface maps, LANDSAT may provide sufficient accuracies for some users.

N78-12507*# Calspan Corp., Buffalo, N. Y.
APPLICATIONS OF HCMM SATELLITE DATA Quarterly Report, 23 Aug. - 23 Nov. 1977
23 Nov. 1977 2 p ERTS
(Contract NAS5-24263)
(E78-10033; NASA-CR-155257; QR-1) Avail: NTIS HC A02/MF A01 CSCL 05B

There are no author-identified significant results in this report.

N78-12508*# Caspan Corp., Houston, Tex.
INDEXING, SCREENING, CODING AND CATALOGING OF EARTH RESOURCES AIRCRAFT MISSION DATA Final Report
[1977] 21 p
(Contract NAS9-15145)
(NASA-CR-151549; SB-6238(A)77C-219) Avail: NTIS HC A02/MF A01 CSCL 05B

Tasks completed are as follows: (1) preparation of large Area Crop Inventory experiment for data base entry;(2) preparation of Earth Observations Aircraft Flight summary reports for publication; (3) updating of the aircraft mission index coverage map and Ames aircraft flight map; (4) preparation of earth observation helicopter flight reports for publication; (5) indexing of LANDSAT imagery; (6) formulation of phase 3 biowindows 1, 2, 3, and 4 listings by country, footprint, and acqusition dates; (7) preparation of flight summary reports; and (8) preparation of an Alaska state index coverage map. Author

N78-12509# Committee on Science and Technology (U. S. House).
EARTH RESOURCES INFORMATION SYSTEM
Washington GPO 1977 677 p refs Hearings before Subcomm. on Space Sci. and Applications of the Comm. on Sci. and Technol., 95th Congr., 1st Sess., No. 18, 21-23 Jun. 1977
(GPO-94-462) Avail: Subcomm. on Space Sci. and Applications

The possibility for establishing an Earth Resources Information System is explored. Federal stimulation and subsidy of early industry investment in an operational system is cited for promoting widespread acceptance of LANDSAT. GRA

N78-12510*# Battelle Columbus Labs., Ohio.
IMPROVED GROUND TRUTH GEOID FOR THE GEOS-3 CALIBRATION AREA
A. George Mourad, S. Gopalapillai, M. Kuhner, and D. M. Fubara Nov. 1977 76 p refs
(Contract NAS6-2451)
(NASA-CR-141431) Avail: NTIS HC A05/MF A01 CSCL 08B

The purpose of this investigation is to develop methods and procedures are reported for computing a detailed geoid to be used as geodetic ground truth for the calibration and verification of GEOS-3 altimeter data. The technique developed is based on rectifying the best available detailed geoid so that the rectified geoid will have correct scale, orientation, shape and position with respect to the geocenter. The approach involved the development of a mathematical model based on a second degree polynomial, in rectangular Cartesian coordinates, describing the geoid undulations at the control stations. A generalized least squares solution was obtained for the polynomial which describes the variation of the undulation differences between the control stations geoid and the gravimetric geoid. Three rectified geoids were determined. These geoids correspond to three sets of tracking station data: (1) WFC/C-band data; (2) GSFC/C-band data; and (3) OSU-275 data. The absolute accuracy of these rectified geoids is linearly correlated with the uncertainties of the tracking station coordinates and, to a certain extent, with those of the detailed geoid being rectified. Author

N78-12511*# Wolf Research and Development Corp., Pocomoke City, Md.
SEAHT: A COMPUTER PROGRAM FOR THE USE OF INTERSECTING ARCS OF ALTIMETER DATA FOR SEA SURFACE HEIGHT REFINEMENT
C. P. Allen and C. F. Martin Nov. 1977 119 p refs
(Contract NAS6-2639)
(NASA-CR-141432) Avail: NTIS HC A06/MF A01 CSCL 13B

The SEAHT program is designed to process multiple passes of altimeter data with intersecting ground tracks, with the estimation of corrections for orbital errors to each pass such that the data has the best overall agreement at the crossover points. Orbit error for each pass is modeled as a polynomial in time, with optional orders of 0, 1, or 2. One or more passes may be constrained in the adjustment process, thus allowing passes with the best orbits to provide the overall level and orientation of the estimated sea surface heights. Intersections which disagree by more than an input edit level are not used in the error parameter estimation. In the program implementation, passes are grouped into South-North passes and North-South passes, with the North-South passes partitioned out for the estimation of orbit error parameters. Computer core utilization is thus dependent on the number of parameters estimated for the set of South-North arcs, but is independent on the number of North-South passes. Estimated corrections for each pass are applied to the data at its input data rate and an output tape is written which contains the corrected data. Author

N78-12512# Virginia Polytechnic Inst. and State Univ., Blacksburg. Virginia Water Resources Research Center.
URBAN WATER RUNOFF AND WATER QUALITY CONTROL Final Report
John T. Wildrick, Kurt Kuhn, and Waldon R. Kerns Dec. 1976 38 p refs
(PB-269411/5; W77-09267) Avail: NTIS HC A03/MF A01 CSCL 13B

Non-point sources of water pollution are considered in the development of water quality management plans for both local and areawide planning. Urban runoff often accounts for a major portion of the non-point pollution load. The purpose of this manual is to explore the possibilities available to urban areas for reducing levels of pollution from urban runoff. The manual contains an assessment of the seriousness of urban non-point pollution, a survey of the control methods available for combating non-point urban pollution, and some planning guidelines for developing an integrated strategy of controls. It is not a technical manual but rather was designed as a general knowledge brochure. Author

N78-12513# Image Graphics, Inc., Fairfield, Conn.
CARTOGRAPHIC ELECTRON BEAM RECORDER (EBR) SYSTEM Final Contract Report, 16 Jun. 1975 - 18 Jul. 1977
Patrick F. Grosso and Andrew A. Tarnowski 1 Aug. 1977 85 p refs
(Contract DAAG53-75-C-0221)
(AD-A044401; ETL-0111) Avail: NTIS HC A05/MF A01 CSCL 08/2

This report describes the development of an advanced model of a Cartographic EBR for use in plotting and recording a variety of map and image data on electron sensitive film. Performance levels achieved with the minicomputer controlled EBR are satisfactory for the automated production of a number of cartographic products. Recording spot sizes of 3 and 6 microns diameter; beam addressability of 32,000 x 32,000; image repeatability of 1/30,000; and geometric fidelity of 0.03% have been demonstrated. Image format sizes were 5 inch x 8 inch, 4 inch x 6 inch, 70 mm and 35 mm. 32 line widths can be varied automatically from 6 to 250 micrometer. Graphic arts quality characters can be recorded from 4 pts to 36 pts (at full scale). Author (GRA)

N78-12514*# Army Cold Regions Research and Engineering Lab., Hanover, N. H.
AIRBORNE SPECTRORADIOMETER DATA COMPARED WITH GROUND WATER-TURBIDITY MEASUREMENTS AT LAKE POWELL, UTAH. CORRELATION AND QUANTIFICATION OF DATA
Carolyn J. Merry Sep. 1977 44 p refs Prepared in cooperation with Dartmouth Coll., Hanover, N. H.
(Grant NsG-5014)
(NASA-CR-155290; AD-A044793; CRREL-SR-77-28) Avail: NTIS HC A03/MF A01 CSCL 13/2

During the past three years there has been a renewed interest in the methodology and procedures used to monitor water quality in fresh and salt water regimes. However, there still exists a need to calculate quantitatively the amount of surface turbidity by remote sensing methods to provide rapid and synoptic water quality surveys. Recently a 500-channel airborne spectroradiometer, which may provide a quantitative means of comparing high resolution multispectral data to water quality parameters, has been designed at the the NASA Goddard Institute for Space Studies (GISS). The objective of this study is to correlate and quantify the airborne spectroradiometer multispectral data to ground truth water quality measurements obtained in Lake Powell, Utah, during June 1975. A ground truth water sampling program was accomplished during 9-16 June 1975 for correlation to an aircraft spectroradiometer flight. Field measurements were taken of percentage of transmittance, surface temperature, pH and secchi disk depth. Also, percentage of transmittance was measured in the laboratory for the water samples. In addition, electron micrographs and suspended sediment concentration data were obtained of selected water samples located at Hite Bridge (Mile 171), Mile 168, Mile 150 and Bullfrog Bay (Mile 122). Airborne spectroradiometer spectra were selected which correlated to the Hite Bridge (Mile 171), Mile 168, Mile 150 and Bullfrog Bay (Mile 122) test sites. GRA

N78-12515# Environmental Research Inst. of Michigan, Ann Arbor.
BASIC REMOTE SENSING INVESTIGATION FOR BEACH RECONNAISSANCE Interim Report, 1 Jan. - 31 Dec. 1976
David Lyzenga, Robert Shuchman, Fred Thomson, Carl F. Davis, and Gwynn H. Suits Sep. 1977 77 p refs
(Contract N00014-74-C-0273)

(AD-A044836; ERIM-108900-9-P) Avail: NTIS HC A05/MF A01 CSCL 14/5

Progress is reported on two tasks designed to develop remote sensing beach reconnaissance techniques applicable to benthic and beach intertidal zones. In Task1--whose goal is to develop remote sensing algorithms for important beach composition and physical parameters--results of radiative transfer model development and application are reported. The model calculates the radiance of a beach, given physical and compositional information. In Task 2--whose goal is to develop remote sensing algorithms for mapping of bottom features in the benthic zone--results of radiative transfer model calculations and an evaluation of the modified ratio algorithm (MRA) performance in scattering waters are presented. Author (GRA)

N78-12516# Systems Research Labs., Inc., Dayton, Ohio.
RESEARCH AND SIMULATION IN SUPPORT OF NEAR REAL TIME/REAL TIME RECONNAISSANCE RPV SYSTEMS Progress Report, Dec. 1975 - Jun. 1976
Gilbert Kuperman, William N. Kama, Joseph Fraggiotti, and John Kettlewell Jun. 1977 262 p refs
(Contract F33615-75-C-0127; AF Proj. 7184)
(AD-A044598; AMRL-TR-77-33) Avail: NTIS HC A12/MF A01 CSCL 15/4

A facility was developed for assessing operator performance in target recognition and interpretation tasks using real time and near real time electrooptical sensor imagery. A programmable image scanner was upgraded to generate simulated sensor imagery under operational flight profiles. A study was performed to compare operator performance against three candidate sensors. The study utilized two V/H levels, the operationally preferred and the minimum commensurate with RPV survivability. Significant findings were developed for the dependent measures of: percent of targets detected, time on display until detection, ground range at detection, slant range at detection, and displayed image scale at detection. Accuracy of interpretation and interpreter confidence did not yield significant results. These results were combined with analytically based performance measures to produce a sensor comparison table in which twelve criteria, weighted by their respective operational impact, were used. A slewable television camera, equipped with zoom optics, and supported by a near real time playback capability achieved the highest performance score. Additionally, seventeen areas were identified in which future investigations could provide operationally important findings to the RPV Special Project Office. Author (GRA)

N78-12517# Synectics Corp., Rome, N. Y.
DIGITAL REVISION TECHNIQUES Final Technical Report, 23 Dec. 1976 - 31 May 1977
Thad B. Kolassa and Albert J. Kreutzer Aug. 1977 243 p
(Contract F30602-76-C-0104; AF Proj. 3204)
(AD-A044611; CT-0727-W; RADC-TR-77-262) Avail: NTIS HC A11/MF A01 CSCL 08/2

This report describes the feasibility of automated digital revision techniques for cartographic products. Evaluation was made of current cartographic software technology and cartographic hardware systems for utilization in automated revision processes. A software concept for automated revision as a batch editing process was designed and procedurally tested and evaluated. Conclusions reached as a result of this effort are set forth and recommendations made for further software development. Author (GRA)

N78-12518# Army Armament Research and Development Command, Aberdeen Proving Ground, Md. Chemical Systems Lab.
INFRARED ABSORPTION SPECTRA ATTRIBUTED TO ION-NUCLEATED WATER CLUSTERS Technical Report, Aug. 1976 - Jun. 1977
Hugh R. Carlon Sep. 1977 22 p refs
(AD-A044661; ARCSL-TR-77-59) Avail: NTIS HC A02/MF A01 CSCL 04/1

Until recently, it was assumed that atmospheric water was found in one of three phases: vapor (monomer), liquid droplets or ice crystals. Now it is known that an ion-nucleated, polymolecular cluster phase of water exists in the vapor phase, as well. These water clusters consist of numbers of water molecules gathered about small ionic nuclei, where the number of molecules per cluster is dependent upon relative humidity and other meteorological parameters. In real atmospheres, mean cluster sizes range from about 11 to about 14 molecules per cluster. Their infrared absorption is due to intermolecular hydrogen bonding, and the 'continuum'-like absorption spectrum which they produce is shifted in wavelength by changes in mean cluster size. Water clusters are always present in the atmosphere and in the cleanest of laboratory experimental equipment. Except under supersaturations of about 420% relative humidity, clusters are not able, because of equilibrium considerations, to attain 'critical' size and to grow to droplets. Water cluster theory and equations give excellent agreement with observed data for infrared 'continuum' absorption. Author (GRA)

N78-12519# Iowa Inst. of Hydraulic Research, Iowa City.
COMPRESSIVE AND SHEAR STRENGTHS OF FRAGMENTED ICE COVERS: A LABORATORY STUDY M. S. Thesis
S. T. Cheng and J. C. Tatinclaux Aug. 1977 96 p refs
(Grant DACA89-76-G-0057)
(AD-A045246; IIHR-206) Avail: NTIS HC A05/MF A01 CSCL 08/12

The results of an experimental study on the compressive and shear strengths of floating, fragmented ice covers are presented. The compressive strength of prestrained covers and of covers submitted to an approximately constant preload was found to be essentially equal to that of unstrained, non-preloaded covers. The compressive strength (sigma cr) became independent of the velocity (Vc) at which the load was applied when Vc became greater than 0.01 ft/sec, and for Vc = 0.01 the ratio of strength to cover thickness (t) and the shear strength (tau) became, approximately constant independent of both vc and t. Differences observed between the present study and that of a previous similar investigation led to the conclusion that small variations in the air and/or water temperatures can have a large effect on sigma cr, and sigma cr/t, probably due to their affecting the formation of cohesive bonds between the ice particles within the ice covers. Author (GRA)

N78-12520# Kentucky Water Resources Research Inst., Lexington.
OPTIMAL SYSTEMS OF STORM WATER DETENTION BASINS IN URBAN AREAS Research Report
D. K. Mynear and C. T. Haan Jun. 1977 92 p refs
(Contract DI-14-34-0001-6081)
(PB-270644/8; RR-104; W77-10184; OWRT-B-046-KY(2))
Avail: NTIS HC A05/MF A01 CSCL 13B

Flood retention basins commonly used in urban areas to reduce the impact of urbanization on downstream flooding were studied. When more than a few acres are developed, systems of retention basins are often required. A procedure was developed whereby the optimum system of basins can be determined to meet a given downstream flow requirement. The method considers design options including basins on all subwatersheds, basins on only some of the subwatersheds, basins of various sizes and basins with various stage-discharge characteristics. The procedure was developed as a computer program to aid in selecting the optimum system of stormwater retention basins. GRA

N78-12521# Pacific Southwest Forest and Range Experiment Station, Berkeley, Calif.
EVALUATION OF SKYLAB (EREP) DATA FOR FOREST AND RANGELAND SURVEYS Final Forest Service Research Paper
Robert C. Aldrich 1976 83 p refs Prepared in cooperation with Rocky Mountain Forest and Range Experiment Station, Ft. Collins, Colo.
(PB-270543/2; FSRP-PSW-113) Avail: NTIS HC A05/MF A01 CSCL 02F

Data products were examined monocularly or stereoscopically using a variety of magnifying interpretation devices. Land use, forest types, physiographic sites, plant communities, and forest stress were interpreted and mapped at sites in Georgia, South Dakota, and Colorado. Microdensitometric techniques and computer assisted data analysis and sampling procedures were developed and tested against ground truth. Results indicate that only Skylab S190B color photographs are good for classification of forest and nonforest land. GRA

N78-12522# Illinois Univ., Urbana-Champaign. Water Resources Center.
OPTIMAL OPERATION OF FLOOD CONTROL SYSTEMS, VOLUME 2 Final Report
Ching-Ju Feng (Northwestern Univ.) and Thomas L. Morin (Northwestern Univ.) Mar. 1977 202 p refs
(Contract DI-14-31-0001-6014; OWRT Proj. A-079-ILL(2))
(PB-270454/2; UILU-WRC-77-0122-Vol-2; W77-09927-Vol-2)
Avail: NTIS HC A10/MF A01 CSCL 13B

The management and control of multiple-reservoir flood control systems is studied. Methodologies are presented that employ dynamic programming and stochastic dynamic programming for the optimal operation of multiple-reservoir flood control systems with deterministic and stochastic inflows, respectively. The methodologies are applied to a number of real-world problems involving river basins in Illinois and elsewhere. The effects of parametrically varying a number of the input parameters are considered. A Markov renewal flood synthesis model and a methodology for determining the optimal capacity of a new flood control reservoir are also presented. GRA

N78-12523# Alaska Univ., College. Inst. of Arctic Environmental Engineering.
TECHNIQUES FOR MEASURING STRESS IN SEA ICE
Richard D. Nelson, Michael Tauriainen, and James Borghorst Jan. 1977 74 p refs
(Grant NOAA-04-5-159-35)
(PB-271270/1; Sea Grant-77-1; NOAA-77071207) Avail: NTIS HC A04/MF A01 CSCL 08L

Techniques for measuring stress in situ in sea ice sheets are described. A technique using embedded load cells was found successful in measuring compressive creep or failure stresses as well as moderate tensile stresses. A stress relief technique was investigated and found unsuccessful. Design details are presented on transducers for each technique and cold-hardy instrumentation is discussed. A technique using inflated air bags to produce known stress fields is presented. GRA

44 ENERGY PRODUCTION AND CONVERSION

Includes specific energy conversion systems, e.g., fuel cells and batteries; global sources of energy; fossil fuels; geophysical conversion; hydroelectric power; and wind power.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power, 28 Propellants and Fuels,* and *85 Urban Technology and Transportation.*

N78-12524*+ National Aeronautics and Space Administration, Washington, D. C.
ENERGY: A CONTINUING BIBLIOGRAPHY WITH INDEXES, ISSUE 13
Apr. 1977 297 p
(NASA-SP-7043(13)) Avail: NTIS HC E05 CSCL 10B

This bibliography lists 1036 reports, articles, and other documents introduced into the NASA scientific and technical information system from January 1, 1977 through March 31, 1977. Author

N78-12525 Iowa State Univ. of Science and Technology, Ames.
DEVOLATILIZATION AND DESULFURIZATION OF IOWA COAL Ph.D. Thesis
Edmund Tao Kang Huang 1977 213 p
Avail: Univ. Microfilms Order No. 77-16960

The devolatilization reaction of coal was studied in nitrogen atmospheres. The ultimate volatile matter released at a given temperature was found to be a function of temperature only. At a constant temperature condition the devolatilization reaction showed three reaction stages. The effective rate constant for each stage obtained at different temperatures was roughly linear on an Arrhenius plot and the effective activation energy for each reaction stage was about 1.2 Kcal/moles. In general, the sulfur reduction increased with temperature and holding time. It was observed in the experiments that some inorganic sulfur was transformed into organic sulfur during the treatment in each of the three gas atmospheres. The most attractive desulfurization process utilizing gas treatment is one that begins with a physical separation step to remove most of the inorganic sulfur and ash. This would be followed by treatment in hydrogen at 700 C. Dissert. Abstr.

N78-12526*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
HIGH EFFICIENCY THIN-FILM GaAs SOLAR CELLS
Richard J. Stirn Sep. 1977 90 p refs
(Contract NAS7-100; Grant NSF AER-76-01823)
(NASA-CR-155323; JPL-Pub-77-60) Avail: NTIS HC A05/MF A01 CSCL 10A

Several oxidation techniques are discussed which have been found to increase the open circuit (V sub oc) of metal-GaAs Schottky barrier solar cells, the oxide chemistry, attempts to measure surface state parameters, the evolving characteristics of the solar cell as background contamination (has been decreased, but not eliminated), results of focused Nd/YAG laser beam recrystallization of Ge films evaporated onto tungsten, and studies of AMOS solar cells fabricated on sliced polycrystalline GaAs wafers. Also discussed are projected materials availability and costs for GaAs thin-film solar cells. Author

N78-12527*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
BUILDING APPLICATION OF SOLAR ENERGY. STUDY NO. 2: REPRESENTATIVE BUILDINGS FOR SOLAR ENERGY PERFORMANCE ANALYSIS AND MARKET PENETRATION
Alan S. Hirshberg 19 Sep. 1975 127 p refs Sponsored by NASA
(NASA-CR-155325; JPL-5040-3) Avail: NTIS HC A07/MF A01 CSCL 10A

The following topics are discussed: (1) Assignment of population to microclimatic zones; (2) specifications of the mix of buildings in the SCE territory; (3) specification of four typical buildings for thermal analysis and market penetration studies; (4) identification of the materials and energy conserving characteristics of these typical buildings; (5) specifications of the HVAC functions used in each typical building, and determination of the HVAC systems used in each building; and (6) identification of the type of fuel used in each building. Author

N78-12528*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
BUILDING APPLICATION OF SOLAR ENERGY. STUDY NO. 4: SCENARIOS FOR THE UTILIZATION OF SOLAR ENERGY IN SOUTHERN CALIFORNIA BUILDINGS, CHANGE 1
E. S. Davis, R. L. French, and A. S. Hirshberg Feb. 1976 72 p refs Sponsored by NASA
(NASA-CR-155326; JPL-5040-10) Avail: NTIS HC A04/MF A01 CSCL 10A

Plausible future market scenarios for solar heating and cooling systems into buildings in the area served by the Southern California Edison Company. A range of plausible estimates for the number of solar systems which might be installed and the electrical energy which might be displaced by energy from these systems are provided. The effect on peak electrical load was not explicitly calculated but preliminary conclusions concerning peak load can be inferred from the estimates presented. Two markets are investigated: the single family market and the large power commercial market. Author

N78-12529*# General Electric Co., Philadelphia, Pa. Valley Forge Space Center.
DESIGN STUDY OF WIND TURBINES 50 kW TO 3000 kW FOR ELECTRIC UTILITY APPLICATIONS. VOLUME 1: SUMMARY REPORT Final Report
Sep. 1976 65 p
(Contracts NAS3-19403; E(49-26)-1010)
(NASA-CR-134934; ERDA/NASA-9403-76/1-Vol-1; Doc-SDS4287-Vol-1) Avail: NTIS HC A04/MF A01 CSCL 10B

Wind turbine configurations that would lead to generation of electrical power in a cost effective manner were considered. All possible overall system configurations, operating modes, and sybsystem concepts were evaluated for both technical feasibility

and compatibility with utility networks, as well as for economic attractiveness. A design optimization computer code was developed to determine the cost sensitivity of the various design features, and thus establish the configuration and design conditions that would minimize the generated energy costs. The preliminary designs of both a 500 kW unit and a 1500 kW unit operating in a 12 mph and 18 mph median wind speed respectively, were developed. The rationale employed and the key findings are summarized. Author

N78-12530*# IBM Watson Research Center, Yorktown Heights, N.Y.
OPTIMIZATION OF SOLAR CELLS FOR AIR MASS ZERO OPERATION AND A STUDY OF SOLAR CELLS AT HIGH TEMPERATURES, PHASE 3 Final Report
A. E. Blakeslee, H. J. Hovel, and J. M. Woodall 1977 41 p refs
(Contract NAS1-12812)
(NASA-CR-145268) Avail: NTIS HC A03/MF A01 CSCL 10A

The etch-back epitaxy process is described for producing thin, graded composition GaAlAs layers. The palladium-aluminum contact system is discussed along with its associated problems. Recent solar cell results under simulated air mass zero light and at elevated temperatures are reported and the growth of thin polycrystalline GaAs films on foreign substrates is developed. Author

N78-12531# Energy Research Corp., Danbury, Conn.
NEW MATERIALS FOR FLUOROSULFONIC ACID ELECTROLYTE FUEL CELLS Final Technical Report, 7 Oct. 1974 - 7 Apr. 1977
Michael George and Stanley Januszkiewicz Jun. 1977 49 p refs
(Contract DAAK02-75-C-0045)
(AD-A044414; ERC-0123-F) Avail: NTIS HC A03/MF A01 CSCL 10/2

Hydrogen-air fuel cells were evaluated with both TFMSA monohydrate and dilute TFMSA. Pressurized monohydrate cells were run at power levels comparable to phosphoric acid fuel cells under similar conditions. Fuel cells with from 25 to 60% TFMSA were evaluated at 25 and 70 C. A cell with 50% TFMSA was run for over 2,000 hours at room temperature without acid replenishment. Power densities in excess of 130mW/sq cm could be achieved at ambient temperatures and pressures with low loading catalysts. The evaluation of supported platinum and tungsten carbide catalyst with dilute TFMSA was initiated. Silicon carbide was investigated as a matrix material with TFMSA.
Author (GRA)

N78-12532# Missouri Univ., Rolla. Dept. of Engineering Management.
ENERGY SYSTEM ANALYSIS PROCEDURE (ESAP) Final Report
John M. Amos Jun. 1977 134 p refs
(Contract F33615-76-C-5384)
(AD-A044131) Avail: NTIS HC A07/MF A01 CSCL 10/3

Energy is vital to any production program and an energy shortage can substantially affect industrial production. The objective of this research project was to develop a system for analyzing the impact of various degrees of energy reductions (shortages) during crises on industrial production facilities participating in Industrial Preparedness Planning (IPP) programs. The researcher developed an Energy System Analysis Procedure (ESAP) for assessing the effects of energy reduction on production planning. The total energy requirements for manufacturing activities are analyzed for their effects on production. The method involves programming of the plant or facility in question from the viewpoint of physical units. The research recommended that the Air Force implement a system to evaluate the effects of energy reduction of IPP plant capabilities and work to enact an energy priority regulation for plants with the IPP program. Also, the research found that most IPP programs are out of date and are not being updated and reviewed periodically. Author (GRA)

N78-12533# General Accounting Office, Washington, D. C. Energy and Minerals Div.
ROCKY MOUNTAIN ENERGY RESOURCE DEVELOPMENT: STATUS, POTENTIAL, AND SOCIOECONOMIC ISSUES
13 Jul. 1977 127 p
(PB-269969/2; EMD-77-23) Avail: NTIS HC A07/MF A01 CSCL 10A

The status of and potential for energy resource development in the Rocky Mountain area was studied. Socioeconomic problems that may result by 1985 from energy resource development in the area are discussed: (1) Federal, State, and industry actions being taken to resolve the problems, (2) the level and type of effort that might be required; and (3) the roles the States, the Federal Government, and industry should play in mitigating these problems. GRA

N78-12534# Battelle Columbus Labs., Ohio.
A SURVEY OF THE USE OF CERAMICS IN BATTERY AND FUEL CELL APPLICATIONS Final Report, Jan. - Jun. 1977
Eric W. Brooman, Keith R. Shillito, and Walter K. Boyd Jun. 1977 101 p refs
(Contract DAAG46-77-M-0460; DA Proj. 1T1-62105-AH-84)
(AD-A044888; AMMRC-CTR-77-18) Avail: NTIS HC A06/MF A01 CSCL 11/2

A survey has been carried out examining the use of ceramics in battery and fuel cell applications. Brief descriptions and characteristics of batteries are presented, including those operating at near ambient and at elevated temperatures. The current technology of fuel cells is also discussed. Finally, a detailed analysis of the problem areas and related research needs for ceramics in these applications is provided together with recommendations for future work in this area. Author (GRA)

N78-12535# Decisions and Designs, Inc., McLean, Va.
AN ATTITUDINAL STUDY OF THE HOME MARKET FOR SOLAR DEVICES Progress Report, Mar. - Sep. 1977
Vincent N. Campbell, Rex V. Brown, Thomas R. Rhees, and Dominic J. Repici Sep. 1977 73 p refs
(Contract N00014-75-C-0426)
(AD-A045082; TR-77-5-25) Avail: NTIS HC A04/MF A01 CSCL 13/1

This study estimates that 1.1 million American residences would have home and hot water heated with solar energy by 1985 if the total cost averaged $20 a month more than the cost of heating with fossil fuels, and initial costs were no barrier. An additional 7.2 million homes would have hot water alone heated with solar energy by 1985 if the total cost was $5 a month more. These are fairly favorable cost assumptions under current conditions. Almost half (44%) of potential homeowners surveyed would prefer to have their living spaces and hot water heated with solar energy if the total cost averaged $20 per month more than conventional heating and initial costs were no barrier. Although interest runs high, for various economic and technical reasons only about 1 in 75 American families may have both their home and water heated with solar energy by 1985. Any development that makes solar energy cost-competitive with fossil fuels for home heating will increase the level of market penetration. Another key to how quickly Americans will have solar homes is how fast builders and developers use solar energy in new homes and can assure good performance.
Author (GRA)

N78-12536# Army Cold Regions Research and Engineering Lab., Hanover, N. H.
INFRARED THERMOGRAPHY OF BUILDINGS: QUALITATIVE ANALYSIS OF WINDOW INFILTRATION LOSS, FEDERAL OFFICE BUILDING, BURLINGTON, VERMONT
Richard H. Munis and Stephen J. Marshall Sep. 1977 21 p
(AD-A044942; CRREL-SR-77-29) Avail: NTIS HC A02/MF A01 CSCL 13/1

An interior, infrared thermographic survey of single-pane, aluminum-frame, projected windows was performed to pinpoint locations of excessive infiltration. Infrared thermographic inspection accomplishes this more quickly and more accurately than conventional techniques of studying window infiltration. This report presents 32 thermograms and photographs which in many cases dramatically illustrate infiltrations (1) around the mullions, (2) along the top opening cracks, and (3) under the frame/sill interfaces. Poor glazing seals were easily detected and the exact points of glass/frame leakages were pinpointed. Plumes of warm air on the window glass, rising from the convectors, were

dramatically captured by the infrared camera system. In several cases, the plumes were noted 12 fr. above the convectors on the top window panels. Heat loss from the convectors was noted through the walls of the building in thermograms taken from the outside. Several recommendations were prepared for the General Services Administration, owner of this Federal Office Building in Burlington, Vermont. Author (GRA)

N78-12537# Stanford Univ., Calif. Systems Optimization Lab.
THE STANFORD PILOT ENERGY/ECONOMIC MODEL
T. J. Connolly, G. B. Dantzig, and S. C. Parikh Jul. 1977 50 p refs
(Contracts N00014-75-C-0865; EY-76-S-03-0326; Grant NSF MCS-76-20019)
(AD-A044908; SU-SOL-77-19) Avail: NTIS HC A03/MF A01 CSCL 05/3

The PILOT Energy Modeling Project is concerned with: (1) performing modeling and methodology research dealing with construction and solution of reasonably large scale mathematical programming models of energy/economic systems; (2) using modeling research towards analysis of some of today's important energy questions; and (3) using the modeling and methodology to construct better models for improved analysis of tomorrow's important energy questions. At the core of this project is the development of a multisector, intertemporal linear programming modeling system that describes in physical terms many of the technological interactions within and across the sectors of the American economy. The general aim of the modeling effort is to permit studies to assess (1) how specific energy policies will affect the energy supply/demand picture and (2) how the physical capacity of the economy over the next 30-35 years to provide goods and services to its populace could be affected by changes in energy supply. Intertemporal linear programming models of the energy sector and the economy provide a unique medium for exploring future energy policy options. GRA

N78-12538# California Univ., Berkeley.
THE URBAN TRAVEL DEMAND FORECASTING PROJECT PHASE 1 FINAL REPORT SERIES. VOLUME 8: DEMOGRAPHIC DATA FOR POLICY ANALYSIS
Daniel McFadden, Stephen Cosslett, Gerald Duguay, and Woo Sik Jung Jun. 1977 94 p refs Sponsored in part by Alfred P. Sloan Foundation, N. Y.
(Grants NSF GI-43740; NSF APR-74-20392)
(PB-270931/9; UCB-ITS-SR-77-10-Vol-8; NSF/RA-770143-Vol-8) Avail: NTIS HC A05/MF A01 CSCL 05C

A forecasting method used to obtain the effects of urban transportation policy is presented. SYNSAM is a methodology for operating a synthetic representative sample of households for an urban area for any specified date. Implementation of this procedure is described for the San Francisco Bay area, involving the construction of a sample of 12,000 households for the year 1976. Data for each household comprise a subset of the socioeconomic variables tabulated in the public use sample of the 1970 Census. The implementation utilizes 1960 and 1970 Census data plus external projections of population and economic conditions. GRA

N78-12539# California Univ., Berkeley. Inst. of Transportation Studies.
URBAN TRAVEL DEMAND FORECASTING PROJECT PHASE 1 FINAL REPORT SERIES. VOLUME 3: DISAGGREGATED SUPPLY DATA COMPUTATION PROCEDURES
Fred A. Reid Jun. 1977 72 p refs
(Grants NSF GI-43740; NSF APR-74-20392)
(PB-270930/1; UCB-ITS-SR-77-8-Vol-3; NSF/RA-770142-Vol-3) Avail: NTIS HC A04/MF A01 CSCL 05C

Methods and conventions used by the urban travel demand forecasting project to prepare disaggregated urban trip time and cost data for use in the development of behavioral travel demand models are presented. Temporally, spatially, and functionally disaggregated times and costs were calculated for individual work trips taken by surveyed samples of employed persons. The surveys were conducted before and after the introduction of the Bay Area Rapid Transit service in the San Francisco Bay area. GRA

N78-12540# ICF, Inc., Washington, D. C.
PROJECT INDEPENDENCE EVALUATION SYSTEM (PIES) DOCUMENTATION. VOLUME 11: FINANCE SUBMODEL FOR THE FEA OIL AND GAS SUPPLY MODEL
Sep. 1976 64 p
(Contract FEA-CO-05-40301-00)
(PB-269948/6; FEA/N-76/421) Avail: NTIS HC A04/MF A01 CSCL 05C

The finance submodel produces industry-wide income statements for the oil and gas producing industries, which permit PIES results to be translated into detailed schedules of oil and gas industry capital requirements. The finance submodel is described in terms of its logic, input data, and output format. GRA

N78-12541# ICF, Inc., Washington, D. C.
PROJECT INDEPENDENCE EVALUATION SYSTEM (PIES) DOCUMENTATION. VOLUME 10: AUTOMATION OF FINDING RATE AND DISCOUNT RATES IN THE FEA GAS SUPPLY MODEL
Sep. 1976 41 p
(Contract FEA-CO-05-50301-00)
(PB-269947/8; FEA/N-76/420-Vol-10) Avail: NTIS HC A03/MF A01 CSCL 05C

The methodology is described which is used to automate, within the model, the laborious calculation of finding rates and discount rates. Early versions of the model required these calculations to be done by hand. GRA

N78-12542# Institute for Energy Analysis, Oak Ridge, Tenn.
ENERGY EMBODIED IN GOODS
David B. Reister Feb. 1977 20 p refs
(Contract EY-76-C-05-0033)
(ORAU/IEA(M)-77-6) Avail: NTIS HC A02/MF A01

The use of cost estimates to reduce uncertainty in net energy analysis was studied. This uncertainty is reduced by estimating average prices for selected goods and services in units of 1967 dollars per ton. When multiplied by energy intensity coefficients, one obtains the energy embodied in 367 different goods in units of Btu per 1967 dollar and, with prices, one can convert these coefficients into units of Btu per ton. This paper also defines the 'atypical product' problem and shows that by using energy intensity coefficients measured in Btu per ton, one obtains more accurate results than by using coefficients measured in Btu per 1967 dollar. ERA

N78-12543# Energy Research and Development Administration, Washington, D. C.
MANAGEMENT PLAN FOR ENHANCED OIL RECOVERY. VOLUME 2: APPENDICES
Feb. 1977 270 p refs
(ERDA-77-15/2-Vol-2-App) Avail: NTIS HC A12/MF A01

Appendices for the management plan for enhanced oil recovery are presented. Included in the 13 appendices are detailed descriptions of candidate enhanced oil recovery (EOR) programs, list of fields and reservoirs in the data base, glossary, EOR models used in the management plan, EOR program strategy for environmental quality assurance, EOR management plan analytical survey, analysis of survey results, and analysis of the sensitivity of the industry base case estimates to the oil price and tax assumptions. ERA

N78-12544# Energy Research and Development Administration, Washington, D. C.
FOSSIL ENERGY RESEARCH PROGRAM OF THE ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION, FY 1978
P. C. White Apr. 1977 378 p refs
(ERDA-77-33) Avail: NTIS HC A17/MF A01

The Fossil Energy (FE) Research, Development, and Demonstration (RD and D) Programs of the Energy Research and Development Administration (ERDA) are expanding in response to the national need to develop adequate amounts of clean fossil fuel from domestic resources. The purpose of this report is to provide additional details on the projects underway and

planned in FE, with specific emphasis on the President's FY 1978 Budget Request. The research documented in this report is guided by the following overall program goals: to develop the technology needed to make fossil fuels available in the form and quantity needed and to assure that the Nation's fossil fuels resources are developed at acceptable economic, social, and environmental costs. These major goals have been translated into funding requirements for each of the programs. ERA

N78-12545# TRW Defense and Space Systems Group, Redondo Beach, Calif. Systems Engineering and Integration Div.
PLANNING AND DESIGN OF ADDITIONAL EAST MESA GEOTHERMAL TEST FACILITIES, PHASE 1B. VOLUME 3: APPENDICES
R. O. Pearson 15 Oct. 1976 130 p refs
(Contract EY-76-C-03-1140)
(SAN/1140-1/3-Vol-3-App) Avail: NTIS HC A07/MF A01

Results of a petrophysical study performed on seven wells in the East Mesa area of the Imperial Valley of California are reported. The wells were drilled on and around the geothermal anomaly that constitutes the East Mesa Field. In each case the objective of the petrophysical study was to determine porosities, permeabilities and salinities in requested intervals, together with the selection of the best sand/shale discriminator. The computed results are reported in table and listing form to show average values of porosity, horizontal and vertical permeabilities together with gross interval, net sand, percent sand and darcy-feet tabulations, layered in 250' intervals throughout each well. The second section of this report is devoted to details of the drilling prognosis for the three geothermal wells to be drilled by the Bureau of Reclamation at their East Mesa site. ERA

N78-12546# California Univ., Livermore. Lawrence Livermore Lab.
PERFORMANCE TESTS OF A TOTAL FLOW IMPULSE TURBINE FOR GEOTHERMAL APPLICATIONS
W. J. Comfort 3 Mar. 1977 31 p refs
(Contract W-7405-eng-48)
(UCID-17411) Avail: NTIS HC A03/MF A01

A two phase expander was successfully tested in the laboratory. An engine efficiency of 23 percent for a single nozzle test was measured. Performance predictions of a numerical model agree well with experimental results. Full admission performance, based upon the numerical model and achievable nozzle thrust coefficients indicate that full admission engine efficiency between 38 and 48 percent can be realized with present technology. Droplet size reduction and enhanced two phase flow analysis techniques should make it possible to reach the research goal of 70 percent engine efficiency. ERA

N78-12547# Department of Health, Education, and Welfare, Washington, D. C. Office of Facilities Engineering and Property Management.
STATE OF THE ART FOR INTEGRATED ENERGY/UTILITY SYSTEMS
Feb. 1977 215 p refs Sponsored in part by NBS
(PB-269684/7) Avail: NTIS HC A10/MF A01 CSCL 10A

A guide to the available technology for Integrated Energy/Utility Systems for campuses, medical centers and communities is presented. It covers in detail those matters that are involved in the technical, economic, environmental, and institutional analyses for integrated energy/utility systems. GRA

N78-12548# General Accounting Office, Washington, D. C. Energy and Minerals Div.
AN EVALUATION OF THE NATIONAL ENERGY PLAN
25 Jul. 1977 186 p refs
(PB-270172/0; EMD-77-48) Avail: NTIS HC A09/MF A01 CSCL 10A

An analysis and comment on the President's National Energy Plan is presented. The report is intended to assist the Congress in considering the legislation that the administration has proposed to implement the plan. GRA

N78-12549# California State Div. of Oil and Gas, Sacramento.
ECONOMIC STUDY OF LOW TEMPERATURE GEOTHERMAL ENERGY IN LASSEN AND MODOC COUNTIES, CALIFORNIA
Apr. 1977 94 p refs Prepared in part by the California Energy Resources Conservation and Development Commission, Sacramento, and VTN-CSL, Irvine, Calif.
(Grant EDA-07-6-01522)
(PB-270256/1; JOB-2175-3; EDA-77-0113) Avail: NTIS HC A05/MF A01 CSCL 10A

The feasibility of using low cost, low temperature geothermal energy in job-producing industries to increase employment and encourage economic development is investigated. The study, encompassing all of Lassen and Modoc Counties is site-specific, referencing candidate geothermal applications to known hot wells and springs. The emphasis is placed on economically practical and readily achievable applications from known resources. Land-use planning, institutional aspects, geological assessments, technical modeling and socioeconomic impacts are examined. GRA

N78-12550# Rocky Mountain Center on Environment, Denver, Colo.
ENERGY CONSERVATION AND STATE LEGISLATURES. BASED ON THE ENERGY CONSERVATION WORKSHOP FOR REGION 8 STATE LEGISLATORS
Susan Carpenter, comp. Dec. 1976 67 p refs Workshop held at Denver, 10-11 Dec. 1976
(PB-270428/6; FEA-76-8-7) Avail: NTIS HC A04/MF A01 CSCL 10A

The purpose of the workshop was to increase the participants' awareness of the general need for energy conservation, to interest legislators in promoting energy conservation legislation, and to provide information about specific practices which can further conservation efforts. GRA

N78-12551# Florida Solar Energy Center, Cape Canaveral.
SOLAR ENERGY COMMERCIALIZATION AT THE STATE LEVEL: THE FLORIDA SOLAR ENERGY WATER HEATER PROGRAM
Milan Johnson and Thomas F. Tiedemann Mar. 1977 142 p refs
(Contract FEA-CA-05-50053-00)
(PB-270158/9; FSEC-76-3; FEA/G-77/270) Avail: NTIS HC A07/MF A01 CSCL 10A

A detailed study was made of current problems associated with the introduction of commercialization of solar technologies in the state of Florida--particularly domestic water heating. Solar energy-related legislation considered by state legislatures is analyzed, with emphasis on actions recommended to accelerate commercialization and use. The study presents proposed standards and programs consistent with suggested comprehensive Florida solar energy commercialization plans. The use of solar water heaters in state buildings as a potential incentive to a local solar energy industry is briefly examined. Included are detailed instructions for constructing a model solar water heater, directed primarily at high school students; and climatological data. GRA

N78-12552# General Accounting Office, Washington, D. C. Community and Economic Development Div.
EFFECTIVE FUEL CONSERVATION PROGRAMS COULD SAVE MILLIONS OF GALLONS OF AVIATION FUEL
15 Aug. 1977 78 p refs
(PB-271249/5; CED-77-98) Avail: NTIS HC A05/MF A01 CSCL 10A

Federal actions to conserve fuel used by the airlines are discussed and additional fuel saving methods are suggested. GRA

45 ENVIRONMENT POLLUTION

Includes air, noise, thermal and water pollution; environment monitoring; and contamination control.

N78-12553*# National Aeronautics and Space Administration, Washington, D. C.
LOCALIZATION OF AN EXPERIMENTAL ECOLOGICAL UNIT IN THE MARADI REGION OF NIGERIA
M. Mainguet, L. Canon, and A. M. Chapelle Nov. 1977 325 p refs Transl. into ENGLISH of "Localization d'une Unite Ecologique

Experiments dans la Region de Maradi (Niger)", Reims Univ., France, Jun. 1977 p 1-300 Transl. by Kanner (Leo) Associates, Redwood City, Calif.
(Contract NASw-2790)
(NASA-TM-75085) Avail: NTIS HC A14/MF A01 CSCL 13B

A detailed topographical and geomorphological description of a specific ecological unit in the Maradi region of the Sahel in the Niger Republic is presented. Sandy structures are classified into active dunes and covered dunes and an extensive vocabulary is developed to describe sub-categories. The descriptions are based on meteorological data (anemometric and rainfall) from local weather stations, ground observations, aerial photographs and LANDSAT picturers. The problem of dune reactivation and desertification is discussed both from the standpoint of causes and possible counter measures. Author

N78-12554*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
LABORATORY MEASUREMENTS OF RADIANCE AND REFLECTANCE SPECTRA OF DILUTE PRIMARY-TREATED SEWAGE SLUDGE
J. W. Usry, William G. Witte, Charles H. Whitlock, and E. A. Gurganus Nov. 1977 27 p refs
(NASA-TP-1038; L-11767) Avail: NTIS HC A03/MF A01 CSCL 13B

The feasibility of remotely monitoring ocean dumping of waste products such as acid and sewage sludge is evaluated. The laboratory arrangement, solar simulator, and test results from three experiments conducted in the laboratory are described. Radiance and reflectance spectra are presented for primary-treated sewage sludge mixed with two types of base water. Results indicate that upwelled reflectance varies in a near-linear manner with concentration and that the sludge has a practically flat signal response between 420 and 970 nm. Well-defined upwelled reflectance spectra were obtained for the sewage-sludge mixtures at all wavelengths and concentrations. The spectral-reflectance values appeared to be influenced by the type of base water, but this influence was small, especially for the mixtures with low concentrations of sewage sludge. Author

N78-12555*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
LABORATORY MEASUREMENTS OF RADIANCE AND REFLECTANCE SPECTRA OF DILUTE SECONDARY-TREATED SEWAGE SLUDGE
William G. Witte, J. W. Usry, Charles H. Whitlock, and E. A. Gurganus Dec. 1977 23 p refs
(NASA-TP-1089; L-11870) Avail: NTIS HC A02/MF A01 CSCL 13B

The National Aeronautics and Space Administration (NASA), in cooperation with the Environmental Protection Agency (EPA) and the National Oceanic and Atmospheric Administration (NOAA), conducted a research program to evaluate the feasibility of remotely monitoring ocean dumping of waste products such as acid and sewage sludge. One aspect of the research program involved the measurements of upwelled spectral signatures for sewage-sludge mixtures of different concentrations in an 11600-liter tank. This paper describes the laboratory arrangement and presents radiance and reflectance spectra in the visible and near-infrared ranges for concentrations ranging from 9.7 to 180 ppm of secondary-treated sewage sludge mixed with two types of base water. Results indicate that upwelled radiance varies in a near-linear manner with concentration and that the sludge has a practically flat signal response between 420 and 970 nm. Reflectance spectra were obtained for the sewage-sludge mixtures at all wavelengths and concentrations. Author

N78-12556# Water Purification Associates, Cambridge, Mass.
WATER CONSERVATION AND POLLUTION CONTROL IN COAL CONVERSION PROCESSES Final Report, Jun. 1975 - Dec. 1976
D. J. Goldstein and David Yung Jun. 1977 486 p refs
(Contract EPA-68-03-2207)
(PB-269568/2; EPA-600/7-77-065) Avail: NTIS HC A21/MF A01 CSCL 13B

Water consumption and environmental impacts of coal conversion processes in Western states are considered. Detailed designs and analyses are given for the Hygas, Synthane, and Solvent Refined Coal (SRC) processes, and for Lurgi combined-cycle power generation. At three proposed sites (in North Dakota, New Mexico, and Wyoming), complete water requirements and effluents including all mining and related off-site uses are given for the power, Hygas, and SRC plants. The Synthane process is analyzed only at the Wyoming Site. GRA

N78-12557# National Academy of Sciences - National Research Council, Washington, D. C. Committee on Hearing Bioacoustics and Biomechanics.
GUIDELINES FOR PREPARING ENVIRONMENTAL IMPACT STATEMENTS ON NOISE
Henning E. VonGierke Jun. 1977 148 p refs
(Contract N00014-75-C-0406)
(AD-A044384) Avail: NTIS HC A07/MF A01 CSCL 20/1

Guidelines are proposed for the uniform description and assessment of the various noise environments potentially requiring an Environmental Impact Statement for Noise. In addition to general, audible noise environments, the report covers separately high-energy impulse noise, special noises such as ultrasound and infrasound, and the environmental impact of structure-borne vibration. Whenever feasible and practical, a single-number noise impact characterization is recommended, based on the new concept of level-weighted population: i.e., the summation over the total population of the product of each residential person times a weighting factor that varies with yearly day-night average sound level outside the residence of that person. A sound-level weighting function for general impact and environmental degradation analysis is proposed, based on the average annoyance response observed in community response studies; this weighting function is supplemented by an additional weighting function at higher noise environments to quantify the potential of noise-induced hearing loss and general health effects. The evaluation of the environmental impact of vibration is derived from existing or proposed ISO standards. The report explains and justifies the procedures selected and gives examples of their application.
Author (GRA)

N78-12558# Exxon Research and Engineering Co., Linden, N. J. Products Research Div.
ASSESSMENT OF AUTOMOTIVE SULFATE EMISSION CONTROL TECHNOLOGY Final Report
M. G. Griffith, R. A. Bouffard, Ei. L. Holt, M. W. Pepper, and M. Beltzer Jun. 1977 159 p
(Contract EPA-68-03-0497)
(PB-270263/7; EPA-460/3-77-008) Avail: NTIS HC A08/MF A01 CSCL 13B

Developing sorbents for SO4(-2) capable of efficiently removing this material from exhaust gas at a low pressure drop over a long service life was studied. Modification II studied three pairs of monolithic automotive oxidation catalysts, nominally identical except for their noble metal components, to determine the effect of composition on the level of SO4(-2) emissions. Modification III tested two types of experimental perovskite-based noble metal automotive oxidation catalysts for CO, HC, and SO2 conversion activity. GRA

N78-12559# Missouri Univ., Columbia. Dept. of Geology.
INFLUENCE OF ORGANIC CARBON AND MICROORGANISMS ON IRON AND SULFIDE CONCENTRATIONS IN GROUNDWATER Final Report, 30 Jun. 1974 - 30 Sep. 1975
Alden B. Carpenter and Ronald Ned Stoufer 22 Jun. 1977 96 p refs
(Contract DI-14-31-0001-3608)
(PB-270640/6; W77-10183; OWRT-B-077-MO(4)) Avail: NTIS HC A05/MF A01 CSCL 13B

Water supply wells in Missouri were sampled to determine the relationships between dissolved organic carbon, microorganisms, iron, and sulfide in unpolluted water. The data suggest a poor correlation between redox potential and the organic carbon content of the water. The data for nitrate-ammonia and sulfate-sulfide indicate that most of the samples were not in internal equilibrium with respect to oxidation-reduction reactions. GRA

N78-12560# Federal Power Commission, Washington, D. C. Bureau of Power.

THE STATUS OF FLUE GAS DESULFURIZATION APPLICATIONS IN THE UNITED STATES: A TECHNOLOGICAL ASSESSMENT, HIGHLIGHTS
Jul. 1977 83 p
(PB-271361/8) Avail: NTIS HC A05/MF A01 CSCL 07A

An historical survey of the research, development and demonstration of flue gas desulfurization (FGD) is presented. The costs of installing, operating, and maintaining FGD systems were discussed, along with alternative technologies for meeting air pollution control regulations. Also examined were coalwashing supplementary control systems and tall stacks, solvent refined coal, cpa, gasification, and fluidized bed combustion. The cost of FGD was compared with present and future alternatives. The chemistry and equipment used in FGD systems currently in full scale commercial application were analyzed. Results of FGD systems in planning stages, under construction and operating were presented, while eight discontinued, full scale scrubber applications were discussed in detail. GRA

N78-12561# Federal Power Commission, Washington, D. C.
THE STATUS OF FLUE GAS DESULFURIZATION APPLICATIONS IN THE UNITED STATES: A TECHNOLOGICAL ASSESSMENT, REPORT IN FULL
Jul. 1977 549 p
(PB-271362/6) Avail: NTIS HC A23/MF A01 CSCL 07A
For abstract, see N78-12560.

N78-12562# Southern Research Inst., Birmingham, Ala.
HP-25 PROGRAMMABLE POCKET CALCULATOR APPLIED TO AIR POLLUTION MEASUREMENT STUDIES: STATIONARY SOURCES Final Report, Dec. 1976 - Apr. 1977
James W. Ragland, Kenneth M. Cushing, Joseph D. McCain, and Wallace B. Smith Jun. 1977 129 p refs
(Contract EPA-68-02-2131)
(PB-269666/4; SORI-EAS-77-329; EPA-600/7-77-058) Avail: NTIS HC A07/MF A01 CSCL 13B

Detailed descriptions are given of 22 separate programs, written specifically for a manually programmable pocket calculator. Each program includes a general description, formulas used in the problem solution, program listings, user instructions, and numerical examples. Areas covered include: calibrating a flame photometric detector by the permeation tube technique, determining channel concentrations for a droplet measuring device, resistivity and electric field strength measurements, determining stack velocity, nozzle diameter, and isokinetic delta H for a high-volume stack sampler, and several cascade impactor programs. GRA

N78-12563# GCA Corp., Bedford, Mass. Technology Div.
DESIGN, DEVELOPMENT, AND DEMONSTRATION OF A FINE PARTICULATE MEASURING DEVICE Final Report, Jul. 1973 - Aug. 1975
Pedro Lilienfeld, Daniel P. Anderson, and Douglas W. Copper Apr. 1977 132 p refs
(Contract EPA-68-02-1341)
(PB-270084/7; GCA-TR-76-27-G; EPA-600/2-77-077) HC A07/MF A01 CSCL 14B

Design, development, and testing are elaborated for a fine particulate source monitoring instrument for real-time measurement of mass concentration as a function of aerodynamic particle size. The device size-segregates particulates using inertial jet-to-plate impaction on a continuously moving substrate, and determines collected mass using beta radiation attenuation. The collection-detection system consists of a 7-impaction-stage cascaded configuration for direct insertion into a stack, with beta mass sensing at each collection stage. The instrument was tested satisfactorily in a test tunnel at room temperature. GRA

N78-12564# Research Corp. of New England, Wethersfield, Conn.
COMPLIANCE DATA SYSTEM USERS GUIDE
Rita Reimer and Geza Serenyi May 1977 283 p refs
(Contract EPA-68-01-3173)
(PB-270363/5; EPA-340/1-76-011) Avail: NTIS HC A13/MF A01 CSCL 13B

Compliance Data System (CDS) User's Guide is designed to be the primary source of user documentation regarding CDS. It replaces all documentation dated prior to December 1976, which should be discarded. The guide is organized to be used effectively by several groups of potential readers. GRA

N78-12565# Monsanto Research Corp., Dayton, Ohio.
SOURCE ASSESSMENT: NONCRITERIA POLLUTANT EMISSIONS Final Report
E. C. Eimutis and R. P. Quill Jul. 1977 116 p
(Contract EPA-68-02-1874)
(PB-270550/7; MRC-DA-692; EPA-600/2-77-107-e) Avail: NTIS HC A06/MF A01 CSCL 13B

Stationary sources that emit each of 320 noncriteria pollutants are listed. Quantities of such emissions are also indicated. The list was prepared using a computerized data base established for emissions of air pollutants from approximately 600 stationary source types in the combustion, organic materials, inorganic materials, and open source categories. GRA

N78-12566# Monsanto Research Corp., Dayton, Ohio.
SOURCE ASSESSMENT: STATE-BY-STATE LISTING OF CRITERIA POLLUTANT EMISSIONS Final Report
E. C. Eimutis and R. P. Quill Jul. 1977 148 p refs
(Contract EPA-68-02-1874)
(PB-270549/9; MRC-DA-686; EPA-600/2-77-107-b) Avail: NTIS HC A07/MF A01 CSCL 13B

Mass emissions of criteria pollutants from stationary sources are listed on a state-by-state basis. The list was prepared, using a computerized data base established for emissions of air pollutants from approximately 600 stationary source types in the combustion, organic materials, inorganic materials, and open source categories. The state-by-state list is in two parts: a summary of state totals and state percentages for each criteria emission; and a report on each state, listing any source type which emits at least 1 percent of the state's total mass of emissions of any criteria pollutant. GRA

N78-12567# Washington Univ., Seattle. Dept. of Civil Engineering.
AEROSOL CHARACTERISTICS AND VISIBILITY Interim Report, Apr. 1971 - Dec. 1974
Alan P. Waggoner and Robert J. Charlson Jul. 1977 46 p refs
(Grant EPA-R-800665)
(PB-269944/5; EPA-600/3-77-072) Avail: NTIS HC A03/MF A01 CSCL 14B

Progress in measuring the optical properties of aerosols and in relating aerosol characteristics to visibility reduction was summarized. The integrating nephelometer, which measures the scattering component of extinction, b(sp), was developed and used in several field studies. Measured b(sp) and observer visibility were shown to be highly correlated. Measured b(sp) was highly correlated with suspended particle volume in the 0.1 to 1.0 micrometer size range. A correlation was found between b(sp) and particle mass as collected on a filter. Techniques were developed to measure b(sp) as a function of relative humidity for ambient and model aerosols. GRA

N78-12568# Stone (Ralph) and Co., Inc., Los Angeles, Calif.
INDUSTRIAL POLLUTION CONTROL. VOLUME 1: EXECUTIVE SUMMARY
Apr. 1977 113 p refs
(Contract AID/ta-C-1091)
(PB-270178/7) Avail: NTIS HC A06/MF A01 CSCL 13B

Information is provided relating to the impact and control of environmental pollution from industrial sources. Volume 1 provides background information and reference sources to facilitate general policy decisions relating to the control of industrial pollutants. Volume 2 is concerned with the technical application and comparative costs of pollution abatement in manufacturing operations. The general principles and control methods discussed in the report are applicable to pollutants from both industrial and non-industrial sources. GRA

N78-12569# Stone (Ralph) and Co., Inc., Los Angeles, Calif.
INDUSTRIAL POLLUTION CONTROL. VOLUME 2: TECHNOLOGICAL STRATEGIES
Apr. 1977 475 p refs
(Contract AID/ta-C-1091)
(PB-270179/5) Avail: NTIS HC A20/MF A01 CSCL 13B
For abstract, see N78-12568.

N78-12570# Joint Publications Research Service, Arlington, Va.
TRANSLATIONS ON ENVIRONMENTAL QUALITY, NO. 153
16 Nov. 1977 72 p refs Transl. into ENGLISH from the world press
(JPRS-70171) Avail: NTIS HC A04/MF A01

The serial report contains translations from the world press of articles and press commentary on environmental pollution and its effects and pollution control technology, organizations, and programs. Author

N78-12571 This accession not used.

N78-12572 This accession not used.

N78-12573# Environmental Protection Agency, Ann Arbor, Mich. Standards development and Support Branch.
EMISSION LABORATORY CORRELATION STUDY BETWEEN EPA AND HONDA MOTOR COMPANY, INCORPORATED
Richard E. Lowery Apr. 1974 36 p
(PB-271012/7; CORR-74-7) Avail: NTIS HC A03/MF A01 CSCL 13B

The results are presented of a laboratory correlation study between EPA and Honda Motor Company, Inc. The report specifically compares Honda's certification test site at its Suzuki laboratory to EPA's certification test site No. 6. In general, the test sites compared in this study showed a high degree of equivalency. No significant differences were discovered in dynamometer or CVS characteristics, and vehicle emission test results correlated rather well. The only significant discrepancy was laboratory measurement of CO emissions, which could have been the result of laboratory barometric pressure differences. Vehicle variability made an accurate assessment of this effect very difficult. GRA

N78-12574# Joint Publications Research Service, Arlington, Va.
TRANSLATIONS ON ENVIRONMENTAL QUALITY, NO. 152
1 Nov. 1977 53 p Transl. into ENGLISH from Selected Foreign Periodicals (USSR)
(JPRS-70076) Avail: NTIS HC A04/MF A01

Translations from the world press of articles and press commentary are reported. Articles discussing environmental pollution and its effects and pollution control technology, organizations, and programs were cited. Author

46 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; ionospheric and magnetospheric physics; and geomagnetism.

For space radiation see *93 Space Radiation*.

N78-12575 Ohio State Univ., Columbus.
SECULAR MOTION OF THE POLE AND GLOBAL PLATE TECTONICS Ph.D. Thesis
Tomas Soler 1977 223 p
Avail: Univ. Microfilms Order No. 77-17140

The possibility of a true secular motion of the barycenter was studied. Investigations were based on astronomical data compiled during the last 70 years which provided coordinates of the instantaneous pole and clearly showed a persistent drift of the mean pole, or barycenter of the wobble. The method developed assumed the earth modeled as a mosaic of 1 deg X 1 deg crustal blocks, each one moving independently in accordance with its corresponding plate velocities. Also reported were new values for the crustal tensor of inertia and the orientation of its axis of figure, reopening the speculation of the possible sliding of the whole crust over the upper mantle. Dissert. Abstr.

N78-12576 California Univ., Berkeley.
THE THERMAL INTERACTION OF THE CORE AND MANTLE Ph.D. Thesis
Glyn Morgan Jones 1976 81 p
Avail: Univ. Microfilms Order No. 77-15724

A model of the thermal interaction of the core and mantle was constructed to account for certain trends within each cycle of geomagnetic reversals. Trends indicate that reversals are frequent but the latter part of each complete cycle contains long periods of constant polarity. Energy sources and requirements were considered for thermal convection in the core and for maintenance of the geomagnetic dynamo. Experimental observations and numerical studies of thermal convection at high Rayleigh numbers suggested that the convection is intermittent, consisting of rising plumes of material occasionally emitted from a thermal boundary layer that forms above the core-mantle boundary. Dissert. Abstr.

N78-12577 California Univ., Los Angeles.
THE STRUCTURE OF THE UPPER MANTLE OF WESTERN NORTH AMERICA FROM MULTIMODE RAYLEIGH WAVE DISPERSION Ph.D. Thesis
Robert Gordon Mitchel 1977 292 p
Avail: Univ. Microfilms Order No. 77-16189

Modes of propagating surface waves in the earth, which are known to contain valuable information about upper mantle properties in their dispersion curves, were considered. A method was developed which uses many seismograms distributed in an array and converts them into frequency-wavenumber diagrams by a process called 'stacking'. This method was applied to records from an array in the western U.S. and Mexico. Dissert. Abstr.

N78-12578 North Carolina Univ., Chapel Hill.
CONFORMAL CURVATURE OF SPACELIKE CAUCHY DATA AND GRAVITATIONAL RADIATION Ph.D. Thesis
David Kenneth Monroe 1976 138 p
Avail: Univ. Microfilms Order No. 77-17352

The conformal curvature tensor of the intrinsic geometry was investigated. It was found that the eigenvalues of this tensor are in fact reliable coordinate-independent indicators of field-mode excitations and in particular wave-like excitations. Furthermore, from the conformal curvature tensor we can sometimes extract one and even two symmetric and transverse-traceless tensor operators. More specifically, the number of operators available equals two minus the number of field modes excited. These operators are linear and also local so they provide a convenient means of constructing initial data for Einstein's equations. Dissert. Abstr.

N78-12579 Iowa State Univ. of Science and Technology, Ames.
CLAY STRUCTURE AND CREEP BEHAVIOR OF CLAYS AS A RATE PROCESS Ph.D. Thesis
Orhan Erol 1977 121 p
Avail: Univ. Microfilms Order No. 77-16954

A primitive or ideal clay is defined by linear time-deformation relationship implicit in rate process theory, and two strain ratios are defined to incorporate structural variations into the rate process theory: i) mobilization ratio, ii) rupture ratio. These ratios are used as a measure of real clay's structure relative to primitive clay's structure which is characterized by the rate of strain at the inflection point and remains constant during progressive creep deformations. The method of analysis proposed reveals that the equivalent mobilization and rupture ratios correspond to points of equivalent structures on experimental creep curves and this hypothesis was verified by the experimental results.
Dissert. Abstr.

N78-12580# Committee on Aeronautical and Space Sciences (U. S. Senate).
EARTHQUAKE RESEARCH AND KNOWLEDGE
Washington GPO 1975 263 p refs Hearing before Comm. on Aeronautical and Space Sci., 94th Congr., 1st Sess., 26 Apr. 1975
Avail: SOD HC $2.45

The possibility for earthquake hazard reduction in the United States is discussed. It was concluded that the potential for reducing earthquake hazards is critically site specific for any earthquake-prone area. The serious hazards and damage from earthquakes can be reduced or prevented through known technology and by planning and zoning techniques. I.M.

N78-12581*# Colorado Univ., Boulder. Dept. of Astro-Geophysics.
OBSERVED AND THEORETICAL VARIATIONS OF ATMOSPHERIC OZONE Final Report, 1 Jan. - 30 Apr. 1976
Julius London 30 Apr. 1976 39 p refs
(Grant NsG-2126)
(NASA-CR-154595) Avail: NTIS HC A03/MF A01 CSCL 04A

Results are summarized from three areas of ozone research: (1) continued analysis of the global distribution of total ozone to extend the global ozone atlas to summarize 15 years (1957-72) of ground based observations; (2) analysis of balloon borne ozonesonde observations for Arosa, Switzerland, and Hohenpeissenberg, Germany (GFR); (3) contined processing of the (Orbiting Geophysical Observatory-4) satellite data to complete the analysis of the stratospheric ozone distribution from the available OGO-4 data. Results of the analysis of the total ozone observations indicated that the long term ozone variation have marked regional patterns and tend to alternate with season and hemisphere. It is becoming increasingly clear that these long period changes are associated with large scale variations in the general upper atmosphere circulation patterns. For individual titles, see N78-12582 through N78-12583.

N78-12582* Colorado Univ., Boulder.
VARIATIONS INCLUDING POSSIBLE SOLAR CYCLE VARIATIONS OF STRATOSPHERIC OZONE OVER CENTRAL SWITZERLAND
Julius London and Hans-Ulrich Duetsch *In its* Observed and Theoretical Variations of Atmospheric Ozone 30 Apr. 1976 14 p refs Presented at Intern. Ozone Symp., Dresden, 9-17 Aug. 1976 (For availability see N78-12581 03-46)
(Grants NsG-2126; NGR-06-003-127)
Avail: NTIS HC A03/MF A01 CSCL 04A

The annual variation of the total amount of ozone over central Switzerland and the partial pressures in each of 7 layers from the surface to 7.8 m zeta shows the pattern representative of mid-latitude ozone: summer maximum in the troposphere, spring maximum in the lower stratosphere up to 30 mb and summer maximum in the middle stratosphere up to approx. 8 mb. It was also shown that at the level of the ozone maximum the ozone partial pressure has a pronounced period of about 26 months. Total ozone and the ozone concentration in the different layers have marginally significant (at plus or minus sigma) correlations with relative sunspot number. The time lag for these correlations is long in the troposphere (about 36 months) but decreases with height to the level of ozone maximum (to about 2 months). A similar analysis of the data derived from the ozonesonde program at Hohenpeissenberg, Germany (GFR) gave completely consistent results with those discussed above. Author

N78-12583* Colorado Univ., Boulder.
SATELLITE OBSERVATIONS OF THE GLOBAL DISTRIBUTION OF STRATOSPHERIC OZONE
Julius London, John E. Frederick, and Gail P. Anderson *In its* Observed and Theoretical Variations of Atmospheric Ozone 30 Apr. 1976 19 p refs Presented at Intern. Ozone Symp., Dresden, 9-17 Aug. 1976 Submitted for publication (For availability see N78-12581 03-46)
(Grant NsG-2126; NsG-7224; NGR-06-003-127; NSF GA-38134X2)
Avail: NTIS HC A03/MF A01 CSCL 04A

Observations of backscattered radiation from an Orbiting Geophysical Observatory (OGO) Satellite were used to determine the global distribution of ozone in different layers in the middle and upper stratosphere. The derived distributions show significant seasonal and geographic variations with important differences indicated between winter and summer hemisphere distributions. The OGO derived distributions are compared with other observations (rocket and satellite) and with photochemical calculations. It is suggested that the increased ozone mixing ratio in the high latitude winter hemisphere can be accounted for by transport processes up to about 40-45 km and by the effects of seasonal variations of NOX, HOX and temperature in the region above. Author

N78-12584*# Colorado Univ., Boulder.
TESTS OF PHYSICAL MECHANISMS LINKING SOLAR ACTIVITY AND/OR GEOMAGNETIC DISTURBANCES WITH THE LARGE-SCALE CIRCULATION OF THE LOWER STRATOSPHERE AND UPPER TROPOSPHERE Final Report, 1 Jul. 1975 - 30 Sep. 1977
Walter Orr Roberts 7 Dec. 1977 3 p refs
(Grants NsG-7166; NSF DES-75-06540)
(NASA-CR-155283) Avail: NTIS HC A02/MF A01 CSCL 03B

Empirical facts are presented to help in selecting the most probable physical mechanisms that are responsible for the sun-weather connections. I.M.

N78-12585*# Illinois Univ., Urbana. Aeronomy Lab.
A ROCKET-BORNE AIRGLOW PHOTOMETER
L. D. Paarmann and L. G. Smith 1 May 1977 161 p refs
(Grant NGR-14-005-181)
(NASA-CR-155327; UILU-ENG-77-2501; ISSN-0568-0581)
Avail: NTIS HC A08/MF A01 CSCL 04A

The design of a rocket-borne photometer to measure the airglow emission of ionized molecular nitrogen in the 391.4 nm band is presented. This airglow is a well known and often observed phenomenon of auroras, where the principal source of ionization is energetic electrons. It is believed that at some midlatitude locations energetic electrons are also a source of nighttime ionization in the E region of the ionosphere. If this is so, then significant levels of 391.4 nm airglow should be present. The intensity of this airglow will be measured in a rocket payload which also contains instrumentation to measure energetic electron differential flux and the ambient electron density. An intercomparison of the 3 experiments in a nighttime launch will allow a test of the importance of energetic electrons as a nighttime source of ionization in the upper E region. Author

N78-12586*# National Aeronautics and Space Administration, Washington, D. C.
INVERSION METHODS IN ATMOSPHERIC REMOTE SOUNDING
Adarsh Deepak, ed. 1977 609 p refs Workshop held at Hampton, Va., 15-17 Dec. 1976 Sponsored in part by Old Dominion Univ.
(NASA-CP-004) Avail: NTIS HC A99/MF A01 CSCL 04A

The mathematical theory of inversion methods is applied to the remote sounding of atmospheric temperature, humidity, and aerosol constituents. For individual titles, see N78-12587 through N78-12607.

N78-12587*# Leiden Univ. (Netherlands).
HYBRID METHODS ARE HELPFUL
H. C. VanDeHulst *In* NASA. Langley Res. Center Inversion Methods in Atmospheric Remote Sounding 1977 p 1-19 ref (For availability see N78-12586 03-46)
Avail: NTIS HC A99/MF A01 CSCL 04A

Multiple scattering problems in a plane layer often permit the convenient use of different methods joined together. Sample numerical results to illustrate this point refer to X- and Y-functions, asymptotic fitting, the small-loss approximations, polarization in high orders, and photon path distribution. Author

N78-12588*# Universite des Sciences et Techniques de Lille (France).
REVIEW OF RADIATIVE TRANSFER METHODS IN SCATTERING ATMOSPHERES
Jacqueline Lenoble *In* NASA. Langley Res. Center Inversion Methods in Atmospheric Remote Sounding 1977 p 21-40 refs (For availability see N78-12586 03-46)
Avail: NTIS HC A99/MF A01 CSCL 04A

The radiative transfer in a scattering plane-parallel atmosphere is discussed, considering the exact analytical, the computational and the approximate methods. Some results of numerical comparisons are given. Finally, the difficulties of realistic atmospheric models are emphasized. Author

N78-12589*# Arizona Univ., Tucson.
SOME ASPECTS OF THE INVERSION PROBLEM IN REMOTE SENSING
S. Twomey *In* NASA. Langley Res. Center Inversion Methods in Atmospheric Remote Sounding 1977 p 41-65 refs (For availability see N78-12586 03-46)
Avail: NTIS HC A99/MF A01 CSCL 04A

Several commonly used methods for inversion--constrained linear inversion, synthesis (Backus-Gilbert) methods and nonlinear iterative techniques for the Chahine type--are discussed. It is demonstrated that a very close connection exists between Backus-Gilbert solutions and those given by constrained linear inversion. A number of examples of the application of such methods are presented, showing that resolution is not greatly different for quite different algorithms, a result quite in accord with general theoretical considerations: more resolution can be achieved at the expense of introducing greater a priori bias in the procedure. Author

N78-12590*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
GENERALIZATION OF THE RELAXATION METHOD FOR THE INVERSE SOLUTION OF NONLINEAR AND LINEAR TRANSFER EQUATIONS
Moustafa T. Chahine *In its* Inversion Methods in Atmospheric Remote Sounding 1977 p 67-116 refs (For availability see N78-12586 03-46)
(Contract NAS7-100)
Avail: NTIS HC A99/MF A01 CSCL 04A

A mapping transformation is derived for the inverse solution of nonlinear and linear integral equations of the types encountered in remote sounding studies. The method is applied to the solution of specific problems for the determination of the thermal and composition structure of planetary atmospheres from a knowledge of their upwelling radiance. Author

N78-12591*# Oxford Univ. (England). Clarendon Lab.
STATISTICAL PRINCIPLES OF INVERSION THEORY
C. D. Rodgers *In* NASA. Langley Res. Center Inversion Methods in Atmospheric Remote Sounding 1977 p 117-138 refs (For availability see N78-12586 03-46)
Avail: NTIS HC A99/MF A01 CSCL 04A

Statistical methods are used to deal with the inverse problem of radiative transfer. All the available information about an unknown profile can be expressed in the form of values of functions of that profile and error estimates of these values. Estimation theory shows how these values are combined to give an estimate of the unknown profile and its error covariance. Many inversion methods are expressed in this form, although the error estimate is not usually carried out. Practical applications are described, both for inversion of individual profiles, and the global analysis of satellite data. Author

N78-12592*# Air Force Geophysics Lab., Hanscom AFB, Mass.
INVERSE SOLUTION OF THE PSEUDOSCALAR TRANSFER EQUATION THROUGH NONLINEAR MATRIX INVERSION
Jean I. F. King *In* NASA. Langley Res. Center Inversion Methods in Atmospheric Remote Sounding 1977 p 139-153 refs (For availability see N78-12586 03-46)
Avail: NTIS HC A99/MF A01 CSCL 04A

Nonlinear matrix inversion operators have been developed which, applied to observed radiances, infer maximal information regarding atmospheric scattering parameters and vertical distribution of radiant sources and sinks. The algorithm has the attractive feature of noise discrimination, attributing instrumental errors to extra-atmospheric sources. Author

N78-12593*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
BACKUS-GILBERT THEORY AND ITS APPLICATION TO RETRIEVAL OF OZONE AND TEMPERATURE PROFILES
Barney J. Conrath *In its* Inversion Methods in Atmospheric Remote Sounding 1977 p 155-193 refs (For availability see N78-12586 03-46)
Avail: NTIS HC A99/MF A01 CSCL 04A

The inversion method provides a quantitative evaluation of the trade-off between vertical resolution of a retrieved profile and formal root-mean-square (rms) error due to measurement noise propagation. The problem of retrieving the top-side ozone profile from backscattered ultraviolet (BUV) measurements is considered. For measurements of the type currently being obtained with the Nimbus 4 and AE-E BUV experiments, it is found that a vertical resolution of approximately 0.75 scale height can be achieved for a formal volume mixing ratio profile error of 10%. Other examples include treatments of the retrieval of temperature profiles from measurements in the 15 micron CO2 absorption band for both the terrestrial and Martian atmospheres. Finally, the method is applied to the problem of retrieving temperature profiles of the Jovian planets from measurements in the far infrared pressure induced H2 lines to be obtained from the Mariner Jupiter/Saturn fly-by missions. Author

N78-12594*# National Center for Atmospheric Research, Boulder, Colo.
INVERSION OF INFRARED LIMB EMISSION MEASUREMENTS FOR TEMPERATURE AND TRACE GAS CONCENTRATIONS
John C. Gille and Paul L. Bailey *In* NASA. Langley Res. Center Inversion Methods in Atmospheric Remote Sounding 1977 p 195-216 refs Sponsored by NSF (For availability see N78-12586 03-46)
Avail: NTIS HC A99/MF A01 CSCL 04A

Limb emission measurements are characterized by sharp weighting functions at high altitudes, and for temperature determinations, strongly nonlinear dependence of the weighting function on the temperature. Several methods for inverting this type of measurement have been described and used, including iterative, statistical, nonlinear and approximate direct approaches. These approaches are described and advantages and disadvantages of each are outlined. Author

N78-12595*# Draper (Charles Stark) Lab., Inc., Cambridge, Mass.
INVERSION OF SCATTERED RADIANCE HORIZON PROFILES FOR GASEOUS CONCENTRATIONS AND AEROSOL PARAMETERS
Harvey L. Malchow and Cynthia K. Whitney *In* NASA. Langley Res. Center Inversion Methods in Atmospheric Remote Sounding 1977 p 217-263 refs (For availability see N78-12586 03-46)
(Contract NAS1-14150)
Avail: NTIS HC A99/MF A01 CSCL 04A

Techniques have been developed and used to invert limb scan measurements for vertical profiles of atmospheric state parameters. The parameters which can be found are concentrations of Rayleigh scatters, ozone, NO2, and aerosols, and aerosol physical properties including a Junge-size distribution parameter and real and imaginary parts of the index of refraction. Author

N78-12596*# Old Dominion Univ., Norfolk, Va.
INVERSION OF SOLAR AUREOLE MEASUREMENTS FOR DETERMINING AEROSOL CHARACTERISTICS

Adarsh Deepak *In* NASA. Langley Res. Center Inversion Methods in Atmospheric Remote Sounding 1977 p 265-295 refs Prepared in cooperation with Inst. for Atmospheric Optics and Remote Sensing, Hampton, Va. (For availability see N78-12586 03-46)
(Grant NsG-1252)
Avail: NTIS HC A99/MF A01 CSCL 04A

Solar aureole radiance is very sensitively dependent on the aerosol size distributions. The photographic solar aureole isophote (PSAI) measurement technique for determining the aerosol size distribution and other characteristics takes advantage of this sensitivity. Single scattering theory of the solar aureole is given. The assumptions and conditions imposed on the single scattering theory to make it tractable to inversion are discussed. The important role of the almucantar measurements is also discussed. Author

N78-12597*# Florida Univ., Gainesville.
ANALYTIC MODEL APPROACH TO THE INVERSION OF SCATTERING DATA
Alex E. S. Green and Kenneth F. Klenk *In* NASA. Langley Res. Center Inversion Methods in Atmospheric Remote Sounding 1977 p 297-324 refs Sponsored in part by NASA and NSF (For availability see N78-12586 03-46)
Avail: NTIS HC A03/MF A01 CSCL 04A

An analytic model approach is applied to several simple atmospheric inversion problems. This method gives a sharp determination of aerosol size distribution parameters. It is shown that this analytic approach, together with ground level point sampling data measurements, can be used to infer information on the tropospheric ozone profile. Author

N78-12598*# National Environmental Satellite Service, Washington, D. C.
COMPARISON OF LINEAR INVERSION METHODS BY EXAMINATION OF THE DUALITY BETWEEN ITERATIVE AND INVERSE MATRIX METHODS
Henry E. Fleming *In* NASA. Langley Res. Center Inversion Methods in Atmospheric Remote Sounding 1977 p 325-360 refs (For availability see N78-12586 03-46)
Avail: NTIS HC A99/MF A01 CSCL 04A

Linear numerical inversion methods applied to atmospheric remote sounding generally can be categorized in two ways: (1) iterative, and (2) inverse matrix methods. However, these two categories are not unrelated; a duality exists between them. In other words, given an iterative scheme, a corresponding inverse matrix method exists, and conversely. This duality concept is developed for the more familiar linear methods. The iterative duals are compared with the classical linear iterative approaches and their differences analyzed. The importance of the initial profile in all methods is stressed. Calculations using simulated data are made to compare accuracies and to examine the dependence of the solution on the initial profile. Author

N78-12599*# Massachusetts Inst. of Tech., Cambridge.
INVERSION OF PASSIVE MICROWAVE REMOTE SENSING DATA FROM SATELLITES
David H. Staelin *In* NASA. Langley Res. Center Inversion Methods in Atmospheric Remote Sounding 1977 p 361-394 refs (For availability see N78-12586 03-46)
(Contracts NAS5-21980; F19628-75-C-0122)
Avail: NTIS HC A99/MF A01 CSCL 04A

Global passive microwave observations from earth-orbiting satellites have mapped humidity and liquid water over ocean, temperature profiles, ice and snow, and other geophysical parameters. In most applications, the inversion problem is adequately approximated as linear with jointly Gaussian statistics, and, thus, a linear retrieval performs well. In some cases, the problem is typically factored into a decision process followed by appropriate linear or quasilinear processes. Certain problems, however, require more powerful nonlinear or nonstationary procedures, such as Kalman filtering. Author

N78-12600*# National Oceanic and Atmospheric Administration, Boulder, Colo. Wave Propagation Lab.
APPLICATION OF STATISTICAL INVERSION TO GROUND-BASED MICROWAVE REMOTE SENSING OF TEMPERATURE AND WATER VAPOR PROFILES
E. R. Westwater and M. T. Decker *In* NASA. Langley Res. Center Inversion Methods in Atmospheric Remote Sounding 1977 p 395-427 refs (For availability see N78-12586 03-46)
Avail: NTIS HC A99/MF A01 CSCL 04A

Surface-based observations of downwelling microwave thermal emission are related to temperature and humidity profiles via a standard integral equation of radiative transfer. Both in clear and in cloudy atmospheres, statistical inversion techniques are used to retrieve profiles from a data vector of brightness observations and surface meteorological constraints. For the clear case, accuracy predictions and profile retrievals are illustrated for: (1) single frequency angular scanned data; (2) multi-frequency angular scanned data; and (3) multi-frequency zenith data. For the last case predicted and achieved accuracies were compared in a recently conducted radiometric experiment. Retrievals of cloud contaminated radiometric data are elaborated. Author

N78-12601*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
INVERSION METHODS IN TEMPERATURE AND AEROSOL REMOTE SOUNDING: THEIR COMMONALITY AND DIFFERENCES, AND SOME UNEXPLORED APPROACHES
Alain L. Fymat *In its* Inversion Methods in Atmospheric Remote Sounding 1977 p 429-467 refs (For availability see N78-12586 03-46)
(Contract NAS7-100)
Avail: NTIS HC A99/MF A01 CSCL 04A

The two remote sensing problems of temperature profiling and aerosol characterization (complex refractive index, size distribution) are considered. These problems differ only in the explicit form of the source function which, for aerosols, includes contributions from both single and multiple scattering processes. When the observables are the spectral extinction or the single scattering of the source radiation, the associated problem is completely analogous to the linearized temperature inversion problem. Methods for obtaining the solution of the linear problem are classified following three main categories: (1) derivation of properties that all solutions satisfy, which must then be properties of the actual solution; (2) regularization of the ill-posed problem; and (3) data changes within their domain of uncertainty in order to avoid the basic instability. A number of unexplored methods are indicated. Author

N78-12602*# Arizona Univ., Tucson.
APPLICATION OF MODIFIED TWOMEY TECHNIQUES TO INVERT LIDAR ANGULAR SCATTER AND SOLAR EXTINCTION DATA FOR DETERMINING AEROSOL SIZE DISTRIBUTIONS
B. M. Herman *In* NASA. Langley Res. Center Inversion Methods in Atmospheric Remote Sounding 1977 p 469-503 refs (For availability see N78-12586 03-46)
Avail: NTIS HC A99/MF A01 CSCL 04A

Polarization properties of the angularly scattered laser light from a volume of air are used to determine the size distribution of the aerosol particles within the volume by the use of appropriate inversion techniques. Similar techniques are employed to determine a mean size distribution of the particulates within a vertical column through the atmosphere from determinations of the aerosol optical depth as a function of wavelength. In both of these examples, a modification of an inversion technique originally described by Twomey has been employed. Details of this method are presented as well as results from actual measurements employing bistatic lidar and solar radiometer. Author

N78-12603*# Old Dominion Univ., Norfolk, Va.
THE INVERSION OF STRATOSPHERIC AEROSOL AND OZONE VERTICAL PROFILES FROM SPACECRAFT SOLAR EXTINCTION MEASUREMENTS
William P. Chu *In* NASA. Langley Res. Center Inversion Methods in Atmospheric Remote Sounding 1977 p 505-527 refs (For availability see N78-12586 03-46)
Avail: NTIS HC A99/MF A01 CSCL 04A

The inversions of multi-channel solar extinction measurements have been analyzed for the 0.35-1.0 micron wavelength region to retrieve stratospheric aerosol and ozone vertical profiles using both the constrained linear inversion scheme and the iterative scheme. The inversions of the multi-wavelength solar extinction data obtained from spacecraft have been analyzed based on the

inversion of computer simulated data using various atmospheric models with differing amounts of aerosol and ozone in the stratosphere. The sensitivities of the inversion schemes to different experimental errors are discussed in terms of accuracy and resolution of the retrieved profiles. Author

N78-12604*# Wyoming Univ., Laramie.
INVERSION OF SOLAR EXTINCTION DATA FROM THE APOLLO-SOYUZ TEST PROJECT STRATOSPHERIC AEROSOL MEASUREMENT (ASTP/SAM) EXPERIMENT
Theodore J. Pepin *In* NASA. Langley Res. Center Inversion Methods in Atmospheric Remote Sounding 1977 p 529-554 refs (For availability see N78-12586 03-46)
(Contract NAS1-3213)
Avail: NTIS HC A03/MF A01 CSCL 04A

The inversion methods are reported that have been used to determine the vertical profile of the extinction coefficient due to the stratospheric aerosols from data measured during the ASTP/SAM solar occultation experiment. Inversion methods include the onion skin peel technique and methods of solving the Fredholm equation for the problem subject to smoothing constraints. The latter of these approaches involves a double inversion scheme. Comparisons are made between the inverted results from the SAM experiment and near simultaneous measurements made by lidar and balloon born dustsonde. The results are used to demonstrate the assumptions required to perform the inversions for aerosols. Author

N78-12605*# California Univ., Berkeley.
EFFECTIVE AEROSOL OPTICAL PARAMETERS FROM POLARIMETER MEASUREMENTS
Jacob G. Kuriyan *In* NASA. Langley Res. Center Inversion Methods in Atmospheric Remote Sounding 1977 p 555-575 refs (For availability see N78-12586 03-46)
(Grants NGR-05-007-328; NsG-1270)
Avail: NTIS HC A99/MF A01 CSCL 04A

The theory underlying the interpretation of polarimeter measurements is described. The assumptions of the model are carefully stated so that the results obtained from the ground-based experiment can be understood without ambiguity. The meteorological significance of the parameters is also deduced. With a satellite-borne polarimeter that monitors the upwelling radiation field, the effect of the ground must be taken into account in order to obtain the aerosol parameters. Two methods that hold promise are described. Author

N78-12606*# Atmospheric Environment Service, Ottawa (Ontario).
EXPERIENCE WITH THE INVERSION OF NIMBUS 4 BUV MEASUREMENTS TO RETRIEVE THE OZONE PROFILE
Carleton L. Mateer *In* NASA. Langley Res. Center Inversion Methods in Atmospheric Remote Sounding 1977 p 577-597 refs (For availability see N78-12586 03-46)
Avail: NTIS HC A99/MF A01 CSCL 04A

The relative merits of pressure increment and partial derivative formulations of the ozone inversion problem are discussed briefly. The height range of validity of the retrieved ozone profile and the effects of adding wavelengths to or of dropping wavelengths from the inversion system are indicated. Illustrative results are presented for profiles retrieved from BUV data using Backus-Gilbert, minimum information (Twomey), and quasi-optimum procedures. Author

N78-12607*# Chicago Univ., Ill.
TEMPERATURE SENSING: THE DIRECT ROAD TO INFORMATION
Lewis D. Kaplan *In* NASA. Langley Res. Center Inversion Methods in Atmospheric Remote Sounding 1977 p 599-615 ref (For availability see N78-12586 03-46)
(Grant NSF ATM-72-01381)
Avail: NTIS HC A99/MF A01 CSCL 04A

The retrievability of detailed temperature soundings from remote measurements of emission spectra depends not so much on how the data are treated as on what the data are. It is shown that the shape of the weighting functions depends on the nature of the pressure and temperature dependence of the transmittance, which differ from one part of the spectrum to another as well as with spectral resolution. It is shown that careful selection of channels results in much narrower weighting functions than those corresponding to channels that have actually been used. Author

N78-12608*# College of William and Mary, Williamsburg, Va.
ATLAS OF INFRARED ABSORPTION LINES Final Report
Jae H. Park Nov. 1977 71 p refs Supersedes NASA-CR-144976; N76-22719
(Grant NsG-1203)
(NASA-CR-2925; NASA-CR-144976) Avail: NTIS HC A04/MF A01 CSCL 04A

Infrared absorption line parameters (line strength vs. wavenumber) are presented from 500 to 7000 cm/1 for 15 gases: H2O, CO2, O3, N2O, CO, CH4, O2, SO2, NO, NO2, NH3, HCl, HF, HNO3 and CH3Cl. Author

N78-12609# Stanford Univ., Calif. Dept. of Geophysics.
NEAR FIELD PATTERNS OF SEISMIC RADIATION Final Report, 19 Feb. 1975 - 18 May 1977
Robert L. Kovach and Moshe Israel 31 May 1977 63 p refs (Contract F19628-76-C-0143; ARPA Order 1795)
(AD-A044206; AFGL-TR-77-0117) Avail: NTIS HC A04/MF A01 CSCL 08/11

Near field displacement, velocity and acceleration ground motion are computed for a buried finite strike slip fault using generalized multipolar ray theory to study the effects of rupture velocity, rise time of particle displacement, direction of rupture relative to observing station and the presence of the free surface. Computed displacement seismograms demonstrate that the rise time and rupture velocity can be traded off to produce similar wave shapes emphasizing the difficulty of separating the effects of rise time and rupture velocity. On the other hand, synthetic accelerograms exhibit much character as the rise time becomes a small part of the rupture duration and individual contributions to the acceleration signals such as the P- and S-wave stopping phase can be seen. Near field synthetic accelerograms hold promise for the study of fault rupture parameters. For the strike-slip model studied allowance for the presence of a free surface by doubling of the amplitude of infinite space signals seems to be approximately correct even in the case of computed vertical component accelerograms. However, this result is not generally true for the residual static displacements. The known result of the appearance of Rayleigh waves at horizontal distances greater than five times the source depth is confirmed for dislocation sources. A portion of the near-field coda can be attributed to the presence of crustal layers which must be accurately known before the source radiation can be completely known.
Author (GRA)

N78-12610# Air Force Geophysics Lab., Hanscom AFB, Mass.
COMBINATION OF SATELLITE ALTIMETRIC DATA IN THE SHORT ARC MODE AND GRAVITY ANOMALY DATA Environmental Research Papers
George Hadgigeorge 3 Jun. 1977 28 p refs
(AD-A044177; AFGL-TR-77-0133; AFGL-ERP-598) Avail: NTIS HC A03/MF A01 CSCL 08/5

The computer program SAGG (Satellite Altimetry and Ground Gravity) has been used to determine the global geoid and the earth's gravity field, based on the combination of altimetric observations and gravity anomalies. A typical feature of SAGG is the simultaneous recovery of the orbit parameters and the spherical harmonic potential coefficients. The short arc adjustment mode makes these determinations possible without the requirement of highly precise reference orbits. In this mode, the state vector components are subject to adjustment and represent, in fact, a set of independent weighted parameters. Orbits good to approximately 20 m are adequate for precise reductions. Altimetric data processed by SAGG was gathered by the GEOS-3 satellite over adjacent portions of the Indian and South Pacific Oceans and a portion of the North Atlantic; gravity anomaly data is represented by mean anomalies from over 2200 1 deg x 1 deg geographic blocks. The recovered geoid over most of the globe shows good agreement with gravimetric geoids. This is especially true of the areas covered by GEOS-3 when compared with the earlier reported results of the AFGL computer program SARRA (Short Arc Reduction of Radar Altimetry). GRA

N78-12611# Lockheed Missiles and Space Co., Palo Alto, Calif. Research Lab.
THE TRAPPED RADIATION HANDBOOK, CHANGE 5
John B. Cladis, comp., Gearld T. Davidson, comp., and Lester L. Newkirk, comp. 21 Jan. 1977 103 p refs Prepared in cooperation with GE, Santa Barbara, Calif.
(Contract DNA001-73-C-0065; DNA001-75-C-0023)
(AD-A044305; DNA-2524H-Change-5) Avail: NTIS HC A06/MF A01 CSCL 08/14

The geomagnetic field, like other large-scale phenomena found in nature, is never absolutely quiescent or undisturbed. Field measurements versus time show a variety of disturbances having time durations lasting from a fraction of a second to as long as several days. The patterns are irregular in some cases and smooth in others, and might have a partially periodic or oscillatory structure. Some of the disturbances undoubtedly play a strong role in the particle supply and loss processes that determine the intensities of radiation belts. The numerous types of magnetic disturbances, along with their causes, are discussed in subsequent portions of this section. Appendix 2A describes some of the magnetic indices used in trapped radiation studies to characterize the relative intensities of magnetic disturbances. GRA

N78-12612# Texas A&M Univ., College Station. Center for Tectonophysics.
STUDY, EVALUATE, MEASURE, AND CALCULATE THE THERMAL CRACKING OF ROCKS Final Report, 25 Feb. 1976 - 15 Mar. 1977
John Handin, Melvin Friedman, and C. Branning Johnson May 1977 81 p refs
(Contract F19628-76-C-0122)
(AD-A044238; AFGL-TR-77-0122) Avail: NTIS HC A05/MF A01 CSCL 08/7

Changes of longitudinal-wave velocity (VL), porosity, and Q, together with optical and scanning electron microscopic observations, demonstrate unequivocally that appreciable thermal cracking occurs during slow thermal cycling of Sioux Quartzite. Thermally-induced cracks develop primarily along grain boundaries and secondarily as intragranular cracks. Intragranular cracks are preferentially oriented and appear to be influenced by the preheating residual strain state locked-in the rock. Acoustic emission reveals that thermal cracking occurs only upon exceeding a threshold temperature, which for the Sioux Quartzite ranges between 200 C and 250 C. Thermal cracking increases progressively with increasing temperature, with the largest fraction of cracking occurring prior to the alpha-beta transition of quartz (573 C). In the temperature interval 200-573 C, VL decreased 40% and porosity increases 130%; new porosity is associated with low aspect-ratio cracks. Fracture intensifies during the alpha-beta transition as reflected by an abrupt decrease in Vl, a rapid porosity increase and intense acoustic emission. Above 573 C, thermal cracking continues but at a reduced rate. Porosity continues to increase but is associated primarily with high aspect-ratio cracks. Cooling induces little additional structural damage. GRA

N78-12613# National Bureau of Standards, Washington, D. C. Quantum Chemistry Group.
APPLICATION OF QUANTUM CHEMISTRY TO ATMOSPHERIC CHEMISTRY Semiannual Report
M. Krauss, F. H. Mies, D. B. Neumann, and P. S. Julienn Jun. 1977 25 p refs
(Grant AFOSR-ISSA-77-0011; AF Proj. 9767)
(AD-A044717; AFOSR-77-1214TR) Avail: NTIS HC A02/MF A01 CSCL 20/8

The polarizabilities of ionic states of atoms are quantities of importance in the determination of long range forces between atoms where either excited states are present which are ionic in character or which exhibit a large degree of charge transfer. The electric dipole polarizability represents the major interaction of a static electric field with an atom or ion. A considerable number of methods have been proposed and applied to the calculation of atomic polarizabilities. These range from the solution of the perturbation equations describing the influence of the field on the atoms to very complete variational methods with large numbers of configurations. Author (GRA)

N78-12614# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.
LARGE REGION LOCATION PROBLEMS Ph.D. Thesis
Daniel L. Litwhiler, Jr. 1977 184 p refs
(AD-A044623; AFIT-CI-77-18) Avail: NTIS HC A09/MF A01 CSCL 12/1

The study describes a number of algorithms for solving single facility deterministic location problems in which the planar assumption is not appropriate. Transformations on the non-Euclidean spherical space are combined with efficient solution techniques in En. Extensive use is made of projective, synthetic and analytic geometry. Two algorithms are presented for solving single facility problems with the objective of minimizing the total sum of costs (minisum). Due to the non-convex nature of the problem, a local optimum is obtained. Computational experience in solving a number of test problems is reported. Theoretical results concerning narrowing of the search region are presented as well as a number of special properties of the problem. Application of the single facility results to the location-allocation class of multifacility minisum problem is investigated. GRA

N78-12615# Aerospace Corp., El Segundo, Calif. Space Sciences Lab.
SIGNATURE OF ELECTRIC FIELDS FROM HIGH AND LOW ALTITUDE PARTICLE DISTRIBUTIONS
Paul F. Mizera and Joseph F. Fennell 23 Aug. 1977 21 p refs
(Contract F04701-76-C-0077)
(AD-A044507; TR-0077(2260-20)-13; SAMSO-TR-77-195) Avail: NTIS HC A02/MF A01 CSCL 04/1

Measurements of high altitude (-1.3Re) ions and electrons at auroral energies are used to provide evidence of parallel electric field acceleration over the dusk to midnight auroral regions for both the north and south hemispheres. The data, taken on August 12, 1976 by charged particle spectrometers on the S3-3 satellite, show evidence of potential differences of approx 2 kV below and approx 1 kV above a satellite altitude of 7300 km. Author (GRA)

N78-12616# Ohio State Univ., Columbus. Dept. of Geodetic Science.
SIMULATION STUDY OF AIRBORNE GRADIOMETRY Interim Report
Klaus-Peter Schwarz May 1977 60 p refs
(Contract F19628-76-C-0010; AF Proj. 7600)
(AD-A044768; DGS-253; AFGL-TR-77-0129; Scientific-8) Avail: NTIS HC A04/MF A01 CSCL 08/5

A simulated field of gravity anomalies and second-order gradients is used to study the recovery of gravity anomalies at ground level from measurements at flight level. The spectral properties of gravimetric quantities simulated by an array of mass points are discussed for first and second order gradients and some rules are derived for generating such fields. To study the effect of observational errors, uncorrelated normally distributed errors and correlated errors from a stationary Markov sequence are used. Results agree well with estimates obtained in a previous accuracy study. Computations show that a fast operational program can be obtained by using a least-squares collocation procedure. The programs and a sample computation are part of the report. Author (GRA)

N78-12617# Analytic Sciences Corp., Reading, Mass.
ERROR MODELS FOR PROTOTYPE MOVING-BASE GRAVITY GRADIOMETERS Final Report, 1 Dec. 1975 - 30 Apr. 1977
Warren G. Heller Hanscom AFB, Mass. AFGL 30 Apr. 1977 51 p refs
(Contract F19628-76-C-0079; ARPA Order 2895)
(AD-A044882; TASC-TR-823-1; AFGL-TR-77-0131) Avail: NTIS HC A04/MF A01 CSCL 08/5

In order to adequately understand the advantages and limitations of gradiometers in relation to other gravimetric sensors, some characterization (i.e., a model) of gradiometer sensor errors is required. In past analyses white noise, first-order Markov or bias gradiometer models have been assumed. Such models have been useful for providing insight into navigation, weapon system and gravity survey performance as a function of broad classes of gradiometer errors. In this role the generalized

parametric models have provided indications of the benefits and limitations of gravity gradiometers. Now, as attention turns toward the application of specific gradiometer instruments (e. g., Bell, CSDL and Hughes) to particular survey and navigation missions, there is a need to assess the efficacy of different gravimetric sensors across all gravity field wave-lengths which requires more than parametric representations of the effects of gradiometer error sources. The purpose of this report is to develop preliminary error models for each of the three gradiometers consistent with the current state of their technology. GRA

N78-12618# Physical Dynamics, Inc., La Jolla, Calif.
MEASUREMENT OF AMBIENT MAGNETIC FIELD GRADIENTS USING A SUPER CONDUCTING MAGNETIC GRADIOMETER Final Technical Report, Jan. - Dec. 1976
Walter N. Podney and George H. Gillespie Mar. 1977 152 p refs
(Contract F30602-72-C-0494; ARPA Order 1649)
(AD-A044997; PD-76-107; RADC-TR-77-100) Avail: NTIS HC A08/MF A01 CSCL 20/3

This report presents the results of investigations involving the relationship of the motion of ocean waves to measurement of fluctuating magnetic fields that result from a wave progressing horizontally in a stratified ocean. This report (1) describes design features of a superconducting magnetic gradiometer that will be employed to measure gradients of magnetic fields generated at a fixed point above the ocean surface due to waves passing the oceanographic tower operated by the U.S. Naval Undersea Center near San Diego, CA. In addition, the report gives a formulation describing instrument response to ambient magnetic gradients that are sensibly constant over the distance separating centers of the pickup loops in the gradiometer. This report also presents the first measurements of spectra that characterize noise in the frequency range 5 x 10 (-4) to 20 Hz of a superconducting magnetic gradiometer operating in a magnetically quiet environment. Two techniques that provide means of suppressing noise from nearby magnetic objects are examined. A procedure for operating at the Oceanographic tower that both uses the techniques to suppress noise from magnetization currents in the tower's steel structure, and gives a maximum response to gradients from internal waves is presented.
Author (GRA)

N78-12619# Teledyne Geotechnical, Alexandria, Va. Seismic Data Analysis Center.
TELESEISMIC P-WAVE AMPLITUDES AND SPECTRA AT NTS AND AT THE SHOAL SITE AS COMPARED TO THOSE OBSERVED IN EASTERN NORTH AMERICA
Z. A. Der, M. S. Dawkins, T. W. McElfresh, J. H. Goncz, C. E. Gray, and M. D. Gillispie 2 Sep. 1977 44 p refs
(Contract F08606-77-C-0014; ARPA Order 2551)
(AD-A045096; SDAC-TR-77-9) Avail: NTIS HC A03/MF A01 CSCL 08/11

Three Special Data Collection System (SDCS) stations were deployed at NTS to Measure magnitude residuals and spectral differences relative to two Eastern United States (EUS) stations in order to detern ine the degree of anelastic attenuation under NTS. At the NTS station located on the Climax stock (OB2NV), the average teleseismic body-wave magnitude is .13 magnitude units (m.u.) lower than at HNME and .19 m.u. lower than at RKON. The magnitudes at the two Pahute Mesa sites average .25 m.u. higher than at OB2NV, but calculations show that most of the difference can be attributed to site amplification by low velocity volcanics under Pahute Mesa. At all NTS sites the high frequency content of P-waves is less than at RKON; the difference is statistically significant for two of the three NTS stations, and marginally significant at the third. Measurements at the site of the SHOAL explosion yield similar figures, showing lower high frequency content and lower magnitudes of P-waves relative to EUS. The above results are indicative of anelastic losses of body-waves traversing the mantle under both test sites. GRA

N78-12620# Stanford Research Inst., Menlo Park, Calif.
OBSERVED CHARACTERISTICS OF IONOSPHERICALLY PROPAGATED HF ATMOSPHERICS FROM NORMAL AND SEVERE THUNDERSTORMS
Walter B. Zavoli May 1977 105 p refs
(AD-A044737) Avail: NTIS HC A06/MF A01 CSCL 20/14

Using a directional HF antenna with a nominal beamwidth of 0.5 deg, atmospherics from midwestern thunderstorms classified as severe, and thus likely to produce tornadoes, were studied in California. The antenna was scanned across regions within a one-hop propagation distance likely to develop tornadoes at the time of the test. These regions were selected on the basis of National Weather Service severe weather forecasts. The existence of strong propagation from these regions at the radio frequencies used was verified by means of backscatter soundings. Analysis of the data recorded in those directions and periods for which severe storm events were reported led to the discovery of a class of radio atmospherics significantly different from those radiated during normal thunderstorm activity. Atmospherics of this new type take the form of randomly occurring impulses having certain distinctive characteristics. A technique was devised to extract this class of atmospherics from the remaining radio noise background. Based on 23 hours of data, taken on four separate days, a statistically significant correlation between the reception of these impulses and the presence of remote severe thunderstorms was found. GRA

N78-12621# National Geophysical and Solar-Terrestrial Data Center, Boulder, Colo.
GEOMAGNETIC DATA FOR JANUARY 1976 (AE(7) INDICES AND STACKED MAGNETOGRAMS)
J. H. Allen, C. A. Abaton, and L. R. Morris Jul. 1977 65 p
(PB-271788/2; UAG-60; IMS Data Pub-1; NOAA-77081102)
Avail: NTIS HC A04/MF A01 CSCL 04A

Analog records of geomagnetic variations are presented. Also given are tables, graphs, and statistics from the preliminary derivation of auroral electrojet indices based upon these records. GRA

N78-12622# California Univ., Livermore. Lawrence Livermore Lab.
GEOPHYSICAL AND GEOCHEMICAL MODELS OF THE EARTH'S SHIELDS AND RIFT ZONES
D. H. Chung 25 Feb. 1977 14 p refs
(Contract W-7405-eng-48)
(UCRL-52238) HC A02/MF A01

The geophysical and geochemical models of the earth's stable shields and rift zones are summarized. Two basic crustal types, continental and oceanic, and two basic mantle types, stable and unstable, are described. It is pointed out that both the crust and upper mantle play a strongly interactive role with surface geological phenomena ranging from the occurrence of mountains, ocean trenches, oceanic and continental rifts to geographic distributions of earthquakes, faults, and volcanoes. On the composition of the mantle, there is little doubt regarding the view that olivine constitutes a major fraction of the mineralogy of the earth's upper mantle. Studies are suggested to simulate the elasticity and composition of the earth's lower crust and upper mantle. ERA

N78-12623# National Oceanic and Atmospheric Administration, Boulder, Colo.
SURVEY OF PRACTICE IN DETERMINING MAGNITUDES OF NEAR EARTHQUAKES
R. D. Adams, comp. (Intern. Assoc. of Seismology and Phys. of the Earth's Interior) Aug. 1977 73 p
(PB-271291/7; SE-8-Pt-2; NOAA-77071301-Pt-1) Avail: NTIS HC A04/MF A01 CSCL 08K

Magnitudes of near earthquakes have been assigned from measurements of three different earthquake parameters. The methods employed are summarized. The parameter first used for magnitude determination was the maximum trace amplitude. A second parameter used for magnitude determination is the maximum ratio of the amplitude of ground vibration to its period, and the third method of earthquake magnitude determination is based on signal duration. It is now generally agreed that there are differences in the spectral content of waves generated at the sources of different earthquakes. GRA

N78-12624# United States Committee on Large Dams, N. Y. Committee on Earthquakes.
EVALUATION OF SEISMICITY AT US RESERVOIRS
W. Daly, W. Judd, and R. Meade May 1977 31 p refs
Sponsored by NSF Prepared in cooperation with Calif. Inst. of

Technol., Pasadena
(PB-270036/7; NSF/RA-770120) Avail: NTIS HC A03/MF A01 CSCL 13B

The current state of knowledge regarding reservoir-associated seismicity, in the United States is summarized. All investigators emphasize the importance of regional geology and the state of stress in the earth. Geologic factors to be considered include rock type; nature of bedding planes, joints, and faults; and physical, mechanical, and chemical properties of the rock mass. The seismicity reported in the survey does not equal or exceed the predicted seismicity. The probability that a dam with a large reservoir will induce significant seismic activity can be estimated as P=20/3300=approx. .006. The probability of inducing a destructive earthquake is even less. For a potentially destructive earthquake to be initiated near a reservoir, a unique combination of circumstances must be present and the probability of such combinations existing must be very low. GRA

N78-12625# National Bureau of Standards, Washington, D. C. Inst. for Basic Standards.
THE AIR DENSITY EQUATION AND THE TRANSFER OF THE MASS UNIT
Frank E. Jones Jul. 1977 33 p refs
(PB-270868/3; NBSIR-77-1278) Avail: NTIS HC A03/MF A01 CSCL 07D

A formulation of the equation used for the calculation of air density was developed. The Quinn, Colclough, and Chandler value of the gas constant, currently accepted values of the atomic weights, and recent determinations of the abundances of the various constituents of air were used. The abundance of carbon dioxide was treated as a variable and a factor enabling convenient adjustment of the apparent molecular weight of air for deviation of carbon dioxide abundance from a background value was derived. A new table of compressibility factor for the range of pressure and temperature of interest in standards laboratories has been calculated using recently determined values of virial coefficients. The enhancement factor, which has usually been ignored in air density equations, has been explicitly included in the equation. GRA

47 METEOROLOGY AND CLIMATOLOGY

Includes weather forecasting and modification.

N78-12626# National Weather Service, Silver Spring, Md. Techniques Development Lab.
THUNDERSTORM PREDICTION FOR USE IN AIR TRAFFIC CONTROL (0-6 HOURS TIME RANGE) Final Report, Sep. 1975 - Jan. 1977
M. A. Alaka Jul. 1977 35 p refs
(Contract DOT-FA74WAI-488)
(AD-A045015; FAA-RD-77-40) Avail: NTIS HC A03/MF A01 CSCL 04B

Results of efforts to develop short range thunderstorm forecasts for aviation are reported. In the 0 to 2 hr range, systematic comparisons were made of the capabilities of three techniques of varying complexity in predicting the movement of radar echoes associated with thundery activity. Data sequences of radar data of 10 and 30 minutes were used to produce 10, 30, 60, and 90 minute forecasts. Results show that the complex technique has little advantage over simple techniques which can be implemented locally on the minicomputer. In the 2 to 6 hr range, a combination of classical and model output statistics were used to develop probability forecasts of thunderstorm activity over most of the U. S. east of the Rockies. Author

N78-12627*# Aeronautical Research Associates of Princeton, Inc., N. J.
MODEL PREDICTIONS OF WIND AND TURBULENCE PROFILES ASSOCIATED WITH AN ENSEMBLE OF AIRCRAFT ACCIDENTS Final Report
G. G. Williamson, W. S. Lewellen, and M. E. Teske Washington NASA Jul. 1977 161 p refs
(Contract NAS8-32037)
(NASA-CR-2884; M-225) Avail: NTIS HC A08/MF A01 CSCL 04B

The feasibility of predicting conditions under which wind/turbulence environments hazardous to aviation operations exist is studied by examining a number of different accidents in detail. A model of turbulent flow in the atmospheric boundary layer is used to reconstruct wind and turbulence profiles which may have existed at low altitudes at the time of the accidents. The predictions are consistent with available flight recorder data, but neither the input boundary conditions nor the flight recorder observations are sufficiently precise for these studies to be interpreted as verification tests of the model predictions. Author

N78-12628*# Tennessee Univ., Tullahoma. Space Inst.
NEUTRALLY STABLE ATMOSPHERIC FLOW OVER A TWO-DIMENSIONAL RECTANGULAR BLOCK
Chih Fang Shieh, Walter Frost, and Juergen Bitte Nov. 1977 109 p refs
(Contract NAS8-29584)
(NASA-CR-2926; M-242) Avail: NTIS HC A06/MF A01 CSCL 04B

The phenomena of atmospheric flow over a two dimensional surface obstruction such as a building modeled as a rectangular block are analyzed by an approach using the Navier-Stokes equations with a two equation model of turbulence. The partial differential equations for the vorticity, stream function, turbulence kinetic energy, and turbulence length scale are solved by a finite difference technique. The predicted results are in agreement with the limited experimental data available. Current computed results show that the separation bubble originates from the upper front corner of the block and extends approximately 11.5 block heights behind the block. The decay of the mean velocity along the wake center line coincides almost perfectly with the experimental data. The vertical profiles of the mean velocity defect are also in reasonable agreement with wind tunnel results. Velocity profiles in the mixing region are shown to agree with the error function profile typically found in the shear layer. Details of the behavior of the turbulence kinetic energy and the turbulence length scale are also discussed. Author

N78-12629*# Texas A&M Univ., College Station. Dept. of Meteorology.
FORECASTING THUNDERSTORMS OVER A 2- TO 5-h PERIOD BY STATISTICAL METHODS
Joseph Allen Zak Dec. 1977 124 p refs
(Contract NAS8-31773)
(NASA-CR-2934; M-243) Avail: NTIS HC A06/MF A01 CSCL 04B

Multiple regression with variable selection and principal component analysis were employed to define combinations of parameters from meteorological observations which optimally discriminate between the occurrence and nonoccurrence of thunderstorms. Routine observations of weather elements at five levels in the troposphere during two spring and summer seasons were analyzed objectively onto a 65 km grid which spanned much of the central United States. A thunderstorm occurrence was defined from manually digitized radar observations with a code of four or greater as the basis. The binary variable one or zero for occurrence or nonoccurrence, respectively, was the predictand. Parameters which are measures of atmospheric moisture content, stability, and trigger mechanisms were calculated from gridded fields of surface and upper air observed elements for different times each morning. These parameters were candidate predictors in the variable selection procedures. Data from all grid points and for each day were pooled in order to provide an adequate sample of thunderstorm observations. Author

N78-12630# Air Force Geophysics Lab., Hanscom AFB, Mass.
THE TREATMENT OF LATERAL BOUNDARY CONDITIONS IN LIMITED-AREA MODELS: A PRAGMATIC APPROACH Environmental Research Papers, May 1976 - Apr. 1977
Ralph Shapiro 19 Apr. 1977 68 p refs
(AF Proj. 2310)
(AD-A044176; AFGL-TR-77-0092; AFGL-ERP-594) Avail: NTIS HC A04/MF A01 CSCL 09/2

Mathematical models used to simulate or predict atmospheric behavior are limited in scope because of insufficient knowledge

of the initial conditions and forcing functions. But these limitations are generally dwarfed by the limited capacity and power of even the largest and most powerful computers. Thus, where a solution is required with high resolution for some limited area of interest, it is often impractical to solve the model throughout the entire domain with the same uniformly high resolution. A pragmatic approach is proposed here which overspecifies the artificial lateral boundaries of a fine-mesh, limited-area, nested region and depends upon a high-order phase and amplitude restoring interpolation along with a high-order, but weak, smoothing operator to control noise and ensure versimilitude. The dynamic tests are carried out in the framework of a multilevel primitive equation model and show unequivocally the importance of correct phase information for the lateral boundaries of the fine-mesh region. The results obtained indicate that the simple procedure proposed here should yield satisfactory results in operational fine-mesh, limited-area models. GRA

N78-12631# National Weather Service, Salt Lake City, Utah.
RELATIVE FREQUENCY OF OCCURRENCE OF WARM SEASON ECHO ACTIVITY AS A FUNCTION OF STABILITY INDICES COMPUTED FROM THE YUCCA FLAT, NEVADA RAWINSONDE
Darryl Randerson Jun. 1977 20 p
(PB-271290/9; NOAA-TM-NWS-WR-119; NOAA-77071202) Avail: NTIS HC A02/MF A01 CSCL 04B

A radar echo survey for two warm seasons was used to determine the relative frequency of occurrence of an echo in six selected areas. These areas included the Las Vegas Valley, Lake Mead, and the Spring Mountains, all located in extreme southern Nevada. The occurrence of an echo in these areas was related to both the K and Z indices, calculated from the Yucca Flat, Nevada, 1200Z sounding. The relative frequency of occurrence of an echo was determined for various categories of K and Z. The resulting charts have practical value for estimating the probability of the occurrence of moist convection in the specified areas. GRA

N78-12632# National Oceanic and Atmospheric Administration, Ann Arbor, Mich. Great Lakes Environmental Research Lab.
ON THE USE OF MICROWAVE RADIATION FOR GREAT LAKES ICE SURVEILLANCE
Brenda Blanton Hagman May 1976 18 p refs
(PB-271254/5; NOAA-TM-ERL-GLERL-13; NOAA-77072206) Avail: NTIS HC A02/MF A01 CSCL 04B

A method using microwave remote sensing for ice surveillance was investigated. Microwave systems were found to be advantageous because they can penetrate cloud cover, operate day or night, and provide greater areal coverage at aircraft altitudes than can optical systems. Microwave radar can detect a world of edges and interfaces that correspond to relative amounts of backscattered radiation. Radar was shown effective in classifying certain ice types, conditions, and features, and for aiding ships in ice-covered waters or during severe weather. GRA

N78-12633# Air Force Occupational Measurement Center, Lackland AFB, Tex.
AIRBORNE METEOROLOGICAL/ATMOSPHERIC RESEARCH EQUIPMENT REPAIRMAN
15 Sep. 1977 52 p
(AD-A044647; AFPT-90-302-222) Avail: NTIS MF A01 CSCL 05/9

This report summarizes the results of the administration of the Electronic Principles Inventory to airmen assigned as Airborne Meteorological/Atmospheric Research Equipment Repairmen AFSC 30251. The Data for this report were collected during the period April through June 1977. This report describes: (1) development and administration of the survey instrument and (2) electronic principles used by DAFSC 5-skill level personnel both CONUS and overseas and assigned to selected major commands. GRA

N78-12634# Army Electronics Command, Fort Monmouth, N. J.
ZENITH ANGLE VARIATION OF SATELLITE THERMAL SOUNDER MEASUREMENT
Louis D. Duncan Aug. 1977 19 p refs
(DA Proj. 1L1-62111-AH-71A)
(AD-A044660; ECOM-5828) Avail: NTIS HC A02/MF A01 CSCL 04/2

A simple procedure is presented for normalizing satellite spectral radiance measurements taken at zenith angle theta to corresponding values which would have been observed at zero zenith angle. From simulated data for the DMSP SSH sounder, it is shown that the variation of observed radiance with zenith angle is approximately linear when taken as a function of the square root of the secant of the angle. This relationship is employed to develop the correction formula. Author (GRA)

N78-12635# Atmospheric Sciences Lab., White Sands Missile Range, N. Mex.
FALLOUT PREDICTIONS COMPUTED FROM SATELLITE DERIVED WINDS
Louis D. Duncan and Mary Ann Seagraves Jun. 1977 19 p refs
(DA Proj. 1L1-62111-AH-71)
(AD-A044516; ECOM-5823) Avail: NTIS HC A02/MF A01 CSCL 18/8

The utility of thermal winds computed from satellite thermal sounder observations is investigated. The investigation is in terms of the downrange distance and radial lines used for construction of nuclear fallout predictions. Empirical estimates of the accuracies of these quantities are obtained by comparisons with the same quantities determined from radiosonde data. Sixty sets of colocated satellite and radiosonde observations were used in these evaluations. For each comparison, corresponding fallout predictions were computed for a range of assumed nuclear yields between 100 kilotons and 5 megatons. Thermal winds derived from the satellite data were used at the upper altitude. Tie-on altitudes of 15 and 10 km were used. RMS differences between the predictands derived from the two methods of determining winds yielded values of less than 5 degrees for the radial lines and less than 3 percent for the downrange distance when the 15 km tie-on was used. When the 10 km values were used for tie-on, RMS values for radial line differences varied from 3 to 9.5 degrees, while those for downrange distance varied between 0 and 7.5 percent. GRA

N78-12636# Naval Weather Service Detachment, Asheville, N. C.
SUMMARY OF SYNOPTIC METEOROLOGICAL OBSERVATIONS (SSMO). AUSTRALIAN COASTAL MARINE AREAS, VOLUME 1: AREA 1, PRINCESS CHARLOTTE BAY. AREA 2, CAIRNS. AREA 3, CUMBERLAND ISLANDS. AREA 4, ROCKHAMPTON. AREA 5, BRISBANE. AREA 6, COFFS HARBOUR. AREA 7, SYDNEY. AREA 8, CAPE HOWE NE
Sep. 1977 644 p
(AD-A044518) Avail: NTIS HC A99/MF A01 CSCL 04/2

This report presents marine climatological data for specific coastal areas in 21 different tables including weather occurrence, wind direction and speed, cloud amount, ceiling height, visibility, precipitation, dry bulb, relative humidity, air-sea temperature difference, sea height and period, sea surface temperature and sea level pressure. Author (GRA)

N78-12637# Louisiana State Univ., Baton Rouge. Coastal Studies Inst.
RESPONSE OF COASTAL WATERS TO ATMOSPHERIC FRONTAL PASSAGE IN THE MISSISSIPPI DELTA REGION
Ernest Daddio May 1977 48 p refs
(Contract N00014-75-C-0192)
(AD-A045108; TR-234) Avail: NTIS HC A03/MF A01 CSCL 08/3

Two current vector time series obtained in the Mississippi Bight exhibit clockwise polarized currents of near-inertial frequency that are closely associated with shifting winds. Because of the closeness of the local inertial period and the diurnal tidal period, it is difficult at first glance to determine the true nature of the observed rotary currents. However, complex demodulation at the inertial frequency reveals a strong signal accompanying wind shifts that are usually associated with the passage of atmospheric fronts. Spectral analysis for clockwise and counterclockwise frequencies indicates a highly energetic peak in the inertial-diurnal frequency band for the clockwise spectrum. The rotary

coefficient computed from the autospectra and quadrature spectrum of the vector components gives C sub R = 0.9 in the vicinity of the inertial-diurnal frequency band. A model using wind stress as a forcing function is highly effective in reproducing sinusoidal oscillations seen in the observed current. These oscillations occur in conjunction with shifts in the wind direction. Because of the close association of the near-inertial oscillations with local wind effects, it is concluded that inertial currents are locally induced by wind stress. Furthermore, wind stress not only initiates the rotary currents but is also highly effective in destroying them. Author (GRA)

N78-12638# Kentucky Water Resources Research Inst., Lexington.
STOCHASTIC MODELS FOR PRECIPITATION
Peter Purdue and Z. Govindarajulu 1977 57 p
(Contracts DI-14-31-0001-5017; DI-14-34-0001-6018)
(PB-270647/1; RR-105; W77-10180; OWRT-A-055-KY(2))
Avail: NTIS HC A04/MF A01 CSCL 04B

A stochastic model, using Semi-Markov Processes, was developed to simulate daily rainfall patterns in Kentucky. This model contains many of the currently used models as special cases and is applicable at any station. For use in Kentucky an 8 state Semi-Markov Process was developed and the parameters of the model were determined from historical rainfall data. The model was tested at 4 different stations in Kentucky and the simulated and actual rainfall processes were found to be in good agreement. Finally some long run probabilities were calculated as well as mean return times. An appendix outlining some basic properties of the Semi-Markov Process is included. GRA

N78-12639# National Oceanic and Atmospheric Administration, Boulder, Colo. Weather Modification Program Office.
FLORIDA AREA CUMULUS EXPERIMENT (FACE): OPERATIONAL SUMMARY, 1976
Jun. 1977 186 p refs
(PB-271304/8; NOAA-TM-ERL-WMPO-38; NOAA-77071101)
Avail: NTIS HC A09/MF A01 CSCL 04B

The Florida Area Cumulus Experiment (FACE) continued in 1976 for the 92 days between June 1 and August 31, with randomized seeding and other studies conducted over an area of 13,000 sq km. The project consisted of a Core seeding program and several sub-programs. The Core program consisted of randomized (by days) dynamic seeding of cumulus groups in the FACE target. GRA

N78-12640# National Oceanic and Atmospheric Administration, Ann Arbor, Mich. Great Lakes Environmental Research Lab.
GREAT LAKES ICE COVER, WINTER 1975-1976
George A. Leshkevich Jun. 1977 41 p refs
(PB-271255/2; NOAA-TM-ERL-GLERL-12; NOAA-77072529)
Avail: NTIS HC A03/MF A01 CSCL 04B

A total of 19 composite ice charts were produced to illustrate estimated ice distributions and concentrations on the Great Lakes at weekly intervals from mid-December 1975 through mid-April 1976. According to the definitions of mild, normal, and severe winters, freezing degree-day accumulations indicate that the winter was normal for all lakes. GRA

N78-12641# National Oceanic and Atmospheric Administration, Boulder, Colo. Wave Propagation Lab.
A RESEARCH LASER WEATHER IDENTIFICATION INSTRUMENT
K. B. Earnshaw and Brian Keebaugh Mar. 1977 59 p
(PB-271273/5; NOAA-TM-ERL-WPL-23; NOAA-77070707)
Avail: NTIS HC A04/MF A01 CSCL 04B

An experimental laser weather identification instrument designed to test the feasibility of making automatic identification of precipitation and other obscurations to visibility is described. The nature of the optical signals and electronic processing of these signals to make weather identification are discussed in detail. The authors have given instructions for preparing the instrument prior to taking data, as well as a complete set of electronic circuit diagrams needed for instrument maintenance. GRA

N78-12642# Bureau of Reclamation, Denver, Colo. Div. of Atmospheric Water Resources Management.
GENERALIZED CRITERIA FOR SEEDING WINTER OROGRAPHIC CLOUDS
Larry Vardiman and James A. Moore Jul. 1977 128 p. refs
(PB-270408/8; Skywater-Monograph-1) Avail: NTIS HC A07/MF A01 CSCL 04B

An a posteriori analysis is being conducted using precipitation, rawinsonde, and seeding generator data from seven randomized winter cloud seeding research projects conducted in orographic settings in the Rocky Mountains and on the Pacific Coast. Variables are developed and investigated to establish generalized seedability criteria that are applicable under a variety of meteorological and topographic conditions. The variables are divided into four general categories: time available, water available, nuclei available, and mixing available. The analysis approach is to establish 'windows' under which positive or negative seeding effects would be obtained. GRA

N78-12643# Bureau of Reclamation, Denver, Colo. Div. of Atmospheric Water Resources Management.
GENERALIZED CRITERIA FOR SEEDING WINTER OROGRAPHIC CLOUDS, SUMMARY REPORT
Mar. 1977 15 p
(PB-270407/0; Skywater-Monograph-1-Summ) Avail: NTIS HC A02/MF A01 CSCL 04B

A study is summarized which uses data of past weather modification projects to investigate cloud seeding. Criteria were emphasized which define conditions when cloud seeding will increase snowfall in mountainous terrain and when it will have no effect or decrease precipitation. GRA

48 OCEANOGRAPHY

Includes biological, dynamic and physical oceanography; and marine resources.

N78-12644# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
REMOTE SENSING OF OCEANIC PARAMETERS DURING THE SKYLAB/GAMEFISH EXPERIMENT
Kenneth H. Faller Nov. 1977 43 p refs
(NASA-RP-1012; JSC-S-468) Avail: NTIS HC A03/MF A01 CSCL 08J

Efforts to demonstrate the feasibility of using remotely acquired information to assess and monitor the distribution of oceanic gamefish are described. Data supplied by Skylab and aircraft surveying an area in the Gulf of Mexico with thermal and optical radiometers and cameras were used in conjunction with oceanographic data provided by surface vessels to explore a relationship between oceanographic parameters and remotely acquired data. Thermal scanner imagery and precision radiometric thermometer data obtained by the two aircraft were combined to provide a composite surface temperature map of the test area. Spectral radiometer data were studied in conjunction with surface measurements of chlorophyll-a and turbidity, and several models were developed which predicted these two oceanic parameters from the radiance data. Contour maps of the chlorophyll-a content and turbidity were developed from the best chlorophyll and turbidity models and from surface measurements. Basic problems concerning the remote measurement of the Sicchi extinction depth are discussed, and suggestions are made for improving the remote measurement turbidity. Author

N78-12645*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
LABORATORY MEASUREMENTS OF UPWELLED RADIANCE AND REFLECTANCE SPECTRA OF CALVERT, BALL, JORDAN, AND FELDSPAR SOIL SEDIMENTS
Charles H. Whitlock, J. W. Usry, William G. Witte, and E. A. Gurganus Dec. 1977 36 p refs
(NASA-TP-1039; L-11854) Avail: NTIS HC A03/MF A01 CSCL 08J

An effort to investigate the potential of remote sensing for monitoring nonpoint source pollution was conducted. Spectral reflectance characteristics for four types of soil sediments were

measured for mixture concentrations between 4 and 173 ppm. For measurements at a spectral resolution of 32 mm, the spectral reflectances of Calvert, Ball, Jordan, and Feldspar soil sediments were distinctly different over the wavelength range from 400 to 980 nm at each concentration tested. At high concentrations, spectral differences between the various sediments could be detected by measurements with a spectral resolution of 160 nm. At a low concentration, only small differences were observed between the various sediments when measurements were made with 160 nm spectral resolution. Radiance levels generally varied in a nonlinear manner with sediment concentration; linearity occurred in special cases, depending on sediment type, concentration range, and wavelength. Author

N78-12646# Rhode Island Univ., Narragansett.
SEA GRANT PUBLICATIONS INDEX 1976, VOLUME 1
Parmula K. Weedman, ed. Mar. 1977 217 p
(Grant NOAA-04-6-158-44018; NOAA-77072525)
(PB-271312/1; NSGD-1-76-001) Avail: NTIS HC A10/MF A01 CSCL 05B

The Sea Grant Publications Index lists all materials received by the National Sea Grant Depository (NSGD) in 1976, with the exception of newsletters which appear in the Sea Grant Newsletter Index. It supplements the earlier publications covering the periods 1968-72, 1973, 1974, and 1975. The Index appears in two volumes. This volume, Volume 1, contains the Document Listing. Volume 2 contains the Key-Word-In-Context (KWIC), Author, Corporate, Grant Number, National Technical Information Service Number, and Additional Report Number Indexes. GRA

51 LIFE SCIENCES (GENERAL)

Includes genetics.

N78-12647 Johns Hopkins Univ., Baltimore, Md.
PHYSIOLOGICAL STUDIES OF NITROGEN FIXATION BY BLUE-GREEN ALGAE Ph.D. Thesis
Nancy Moller Weare 1974 194 p
Avail: Univ. Microfilms Order No. 77-16555

In a series of experiments which examined the effects of mechanical blending, oxygen and darkness on nitrogenase activity and photosynthesis in the heterocystous blue green alga, Anabaena cylindrica, it was shown that these activites are spatially separated. Photosynthesis occurs in the vegetative cells, but not in the heterocysts, whereas nitrogenase activity is localized in the heterocysts. A model involving the coupling of photosynthetic products from the vegetative cells with nitrogen fixation in the heterocysts was proposed which is consistent with these data as well as other information in the literature. Dissert. Abstr.

N78-12648*# National Aeronautics and Space Administration, Washington, D. C.
THE ORIGIN OF BIOLOGICAL MACROMOLECULES ON THE EARTH. THE HYPOTHESIS OF INORGANIC TEMPLATE
Tzyy-Shen Lu Oct. 1977 19 p refs Transl. into ENGLISH from Kexue Tongbao (China), vol. 21, no. 3, 1976 p 112-119 Transl. by Sci. Transl. Serv., Santa Barbara, Calif. Original Doc. prep. by China Inst. of Sci.
(Contract NASw-2791)
(NASA-TM-75176) Avail: NTIS HC A02/MF A01 CSCL 06C

Studies about the origin of life are reviewed. The nonrandom organization of organelles is discussed from a structural and functional point of view. After postulating that the origin of biomacromolecules was not a random event, the paper develops the hypothesis that polypeptides and polynucleotides were formed on an inorganic template. Only information-containing structures can pass natural selection and develop through evolution. Author

N78-12649# Toronto Univ. (Ontario). Inst. for Aerospace Studies.
ACUTE CHANGES IN INNER EARS OF LABORATORY ANIMALS CAUSED BY SIMULATED SONIC BOOMS
Stanislav Reinis Sep. 1976 53 p refs Prepared in cooperation with Waterloo Univ., Ontario
(UTIAS-211; CN-ISSN-0082-5255) Avail: NTIS HC A04/MF A01

Inbred mice and chinchillas were subjected to simulated sonic booms of different rise time, intensity, and number of sonic booms. The most important pathological change was found to be bleeding in the basal turn of the scala tympani of the inner ear. A single boom having a rise time of 0.1 mscec, peak overpressure of 3.3 psf, and duration of 120 msec was found to cause bleeding. The frequency of the appearance of blood clots was found to increase with the number of booms administered. This was observed even when the booms were administered one every 24 hours. Bleeding usually disappeared within a period of 8 weeks. Mice suffered a rupture of the basilar membrane and destruction of the Corti organ in the basilar membrane and destruction of the Corti organ in the basal turn of the cochlea in 3 out of 20 cases. Author

N78-12650# Joint Publications Research Service, Arlington, Va.
SPACE BIOLOGY AND AEROSPACE MEDICINE, NO. 5, 1977
10 Nov. 1977 127 p Transl. into ENGLISH from Selected Foreign Periodicals (USSR)
(JPRS-70135) Avail: NTIS HC A07/MF A01

Articles concerning the selection and training of cosmonauts, evaluation and analysis of accumulated data to facilitate the on-going transition from orbital to interplanetary flights, research aimed at guaranteeing safety on long flights and reliability of the human component of the 'man-spaceship' system, space psychology and physiology, environmental problems and control (spacecraft habitability, effects of radiation and weightlessness, etc.) and telemetry are presented. Author

N78-12651# Joint Publications Research Service, Arlington, Va.
TRANSLATIONS ON USSR SCIENCE AND TECHNOLOGY: BIOMEDICAL SCIENCES, NO. 13
31 Oct. 1977 78 p refs Transl. into ENGLISH from Russian journals
(JPRS-70057) Avail: NTIS HC A05/MF A01

Information on aerospace medicine, agrotechnology, bionics and bioacoustics, biochemistry, biophysics, environmental and ecological problems, food technology, microbiology, epidemiology and immunology, marine biology, military medicine, physiology, public health, toxicology, radiobiology, veterinary medicine, behavioral science, human engineering, psychology, psychiatry and related fields, and scientists and scientific organizations in biomedical fields is presented. Author

52 AEROSPACE MEDICINE

Includes physiological factors, biological effects of radiation; and weightlessness.

N78-12652 New Mexico Univ., Albuquerque.
A COMPARISON OF EXERCISE RESPONSES OF MALES AND FEMALES DURING ACUTE EXPOSURE TO HYPOBARIA Ph.D. Thesis
Philip Richard Elliott 1976 153 p
Avail: Univ. Microfilms Order No. 77-16095

This study was designed to investigate the effects of acute altitude exposure on selected pulmonary, cardiovascular, and metabolic variables in men and women during submax and max work. Seventeen male and 20 female physical education students were randomly selected for inclusion in the investigation which took place over an 11-wk period. All testing was conducted in a hypobaric chamber with each subject being tested initially at the terrestrial altitude of 1576 m to which they were acclimated. Subsequent tests were conducted at simulated altitudes of 2743 m and 3962 m. It was concluded that, for the subjects in this study, females tolerated hypoxia better during submax work than did men. During maximal work, the men apparently had a better tolerance for hypoxia than did the women.
Dissert. Abstr.

N78-12653 Kansas Univ., Lawrence.
THE ROLE OF THE ACOUSTIC REFLEX IN THE ACQUISITION OF TEMPORARY THRESHOLD SHIFT Ph.D. Thesis

Clifford Charles Olsen, Jr. 1976 66 p
Avail: Univ. Microfilms Order No. 77-16293

The effects of acoustic reflex activation on the acquisition of temporary threshold shift (TTS) were studied. Acoustic reflex responses were monitored during the presentation of the fatiguing stimulus in the typical TTS experimental paradigm. A measure of TTS was obtained for each session plus a record of acoustic reflex activity elicited by the noise exposure condition producing the TTS. When reflex responses were pooled and averaged, greater reflex activity was found to be elicited by the high band interrupted noise at each off time. For the continuous exposure more reflex activity was elicited by the low band noise. This reversal was attributed to reflex decay in response to the high band continuous noise exposure that was absent in the reflex response to the high band interrupted noise exposure.
Dissert. Abstr.

N78-12654 California Univ., Berkeley.
ON THE SPATIAL BREADTH OF SPATIAL FREQUENCY CHANNELS IN HUMAN VISUAL DETECTION Ph.D. Thesis
Matthew Carl Halter 1976 98 p
Avail: Univ. Microfilms Order No. 77-15709

Human visual detection can be modelled with a series of independent, parallel detection mechanisms called channels. The frequency selectivity and spatial extent of these channels were tested simultaneously. Experimental stimuli contained either one or two half-field sinusoidal grating patches. The findings support existing evidence that sinusoids at different frequencies are detected independently. Two adjacent patches at 4.3 cycles per degree appear to be detected independently. Adjacent patches at 12.8 cycles per degree are detected far more easily than can be explained by the independent detection of each patch. This is taken to mean that the individual striations of sinusoidal gratings at this frequency are not detected independently. Instead, it is concluded that there exists some single mechanism which is not only selective for this frequency but also sensitive to several cycles of the grating. Dissert. Abstr.

N78-12655 Ohio State Univ., Columbus.
A STUDY OF PHYSIOLOGICALLY MOTIVATED MATHEMATICAL MODELS FOR HUMAN POSTURAL CONTROL Ph.D. Thesis
Peter Carrell Camana 1977 288 p ref
Avail: Univ. Microfilms Order No. 77-17082

Biped standing posture control systems were studied, including a nonlinear feedback system, a linear feedback technique identified from human motion and a learning controller modelled after the human cerebellum. Studies of the ankle in humans indicate that in both the center of pressure on the foot and the calf muscle stretch reflex, the human postural control system has a measure of the sine of the leg angle. It is shown here that with proper scaling the measure of the sine of the leg angle can be used to linearize and decouple simple biped models. The control method thus uses nonlinear (sine) feedback along with linear feedback to control posture. Simulations on the computer show much better responses and lower torques than the linear-feedback. A human response to perturbations in stance is used with a gradient search routine to find the linear feedback scheme and values that best matched the human and computer model responses. The results show that humans try to use a decoupling technique for control and that the vestibular system can play a significant role in normal postural control. Dissert. Abstr.

N78-12656# Civil Aeromedical Inst., Oklahoma City, Okla.
ALTITUDE TOLERANCE OF GENERAL AVIATION PILOTS WITH NORMAL OR PARTIALLY IMPAIRED SPIROMETRIC FUNCTION
Michael T. Lategola, Marinus Flux, and Peggy J. Lyne Jul. 1977 13 p refs
(AD-A044557; FAA-AM-77-6) Avail: NTIS HC A02/MF A01 CSCL 06/19

The altitude tolerance of 10 spirometrically impaired (SI) general aviation pilots with an average forces midexpiratory flow value of 65.1 percent was compared to that of 10 spirometrically normal (SN) pilots. Cardiorespiratory parameters assessed at ground level (GL) and at 8,000- and 12,500-ft altitudes were blood pressure, pulmonary ventilation, oxyhemoglobin saturation, temporal artery flow velocity, heart rate, and single-lead electrocardiogram. Although altitude exposure quantitatively displaced the SI group more than the SN group, the differences were not statistically significant at the probability level of 0.05. Unifocal premature ventricular contractions were present at GL in three of the pilots and showed no further changes at altitude. Therefore, the mean FEF 25-75% value of 65 percent of predicted normal for the SI group becomes a reasonable option as an objective screening norm for acceptable tolerance to general aviation altitudes in the ambient-air-breathing range. Author

N78-12657*# National Aeronautics and Space Administration, Washington, D. C.
PROVISIONAL STANDARDS OF RADIATION SAFETY DURING FLIGHTS
Oct. 1977 9 p Transl. into ENGLISH of "Vremennyye Normy Radiatsionnoy Besopasnosti pri Kosmicheskikh Poletakh", VNRB-75 Ministry of Public Health, Moscow, 1976 p 1-8 Transl. by Sci. Transl. Serv., Santa Barbara, Calif.
(Contract NASw-2791)
(NASA-TM-75051) Avail: NTIS HC A02/MF A01 CSCL 06R

Radiation effects during space flights are discussed in the context of the sources and dangers of such radiation and the radiobiological prerequisites for establishing safe levels of radiation dosage. Standard safe levels of radiation during space flight are established. Author

N78-12658*# National Aeronautics and Space Administration, Washington, D. C.
COMPUTERIZED CLASSIFICATION OF AUDITORY TRAUMA: RESULTS OF AN INVESTIGATION ON SCREENING EMPLOYEES EXPOSED TO NOISE
Ingmar Klockhoff Nov. 1977 13 p refs Transl. into ENGLISH from Horselskadeklassifikation med dator: Undersokningsresultat fran screening pa bullerexponerad personal (uppsala), 1974 4 p Transl. by Kanner (Leo) Associated, Redwood City, Calif. Original Doc. prep. by University Hospital, Uppsala (Sweden)
(Contract NASw-2790)
(NASA-TM-75062) Avail: NTIS HC A02/MF A01 CSCL 06S

An automatic, computerized method was developed to classify results from a screening of employees exposed to noise, resulting in a fast and effective method of identifying and taking measures against auditory trauma. This technique also satisfies the urgent need for quick discovery of cases which deserve compensation in accordance with the Law on Industrial Accident Insurance. Unfortunately, use of this method increases the burden on the already overloaded investigatory resources of the auditory health care system. Author

N78-12659*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
MEDICAL ULTRASONIC TOMOGRAPHIC SYSTEM Final Report
Richard C. Heyser, Dennis H. LeCroissette, Robert Nathan, and Robert L. Wilson (Harbor General Hospital, Los Angeles) 1 Oct. 1977 65 p refs
(Contract NAS7-100; Grant GM-23094-01)
(NASA-CR-155269; JPL-Pub-77-72) Avail: NTIS HC A04/MF A01 CSCL 06B

An electro-mechanical scanning assembly was designed and fabricated for the purpose of generating an ultrasound tomogram. A low cost modality was demonstrated in which analog instrumentation methods formed a tomogram on photographic film. Successful tomogram reconstructions were obtained on in vitro test objects by using the attenuation of the fist path ultrasound signal as it passed through the test object. The nearly half century tomographic methods of X-ray analysis were verified as being useful for ultrasound imaging. Author

N78-12660*# Methodist Hospital, Houston, Tex.
AUTOMATED ELECTROENCEPHALOGRAPHY SYSTEM AND ELECTROENCEPHALOGRAPHIC CORRELATES OF SPACE MOTION SICKNESS, PART 4 Final Report
James D. Frost, Jr. 18 Nov. 1977 56 p refs
(Contract NAS9-13870)
(NASA-CR-151560) Avail: NTIS HC A04/MF A01 CSCL 06B

Comparative data for further assessments of the EEG

alterations seen during Skylab are elaborated. The variability of alpha, beta, theta, and delta EEG characteristics was analyzed with quantitative computer techniques in a group of six normal individuals over a period of two months, and the EEG effects of a prolonged period of bed rest were evaluated in two subjects. The results confirm that the inflight EEG changes seen during Skylab are statistically significant, but the absolute values obtained for the various parameters do not exceed the maximal range expected in a normal population. Further, the EEG manifestations of extended bed rest do not appear similar to those of space flight. Author

N78-12661# Naval Medical Research Inst., Bethesda, Md.
A PRELIMINARY HUMAN ENGINEERING EVALUATION OF HYPERBARIC CONTROL SYSTEMS
William W. Banks, David M. Heaney, Arthur J. Bachrach, and George S. Loehring Mar. 1977 44 p refs
(AD-A044044) Avail: NTIS HC A03/MF A01 CSCL 05/4

Past experience in systems design has demonstrated that the use of human factors design criteria can maximize operator/system performance and safety. Yet there has not been adequate communication among operators, investigators, and design engineers. Poor functional interaction between man and machine has been the result. To minimize this problem in a new hyperbaric research facility, an intensive human factors evaluation has been conducted. GRA

N78-12662# Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio.
AERODYNAMIC FORCES EXERTED ON AN ARTICULATED BODY SUBJECTED TO WINDBLAST Final Report, 14 Jun. - 20 Aug. 1976
Daniel J. Schneck Dec. 1976 61 p refs
(AD-A044217; AMRL-TR-76-109) Avail: NTIS HC A04/MF A01 CSCL 06/2

A potential flow solution is presented for estimating the pressure distribution around the forearm of a human body subjected to windblast. The forearm is examined in three positions: resting and pressing against an arm rest; resting, but not pressing against an arm rest; and not resting at all against any surface. Results show that a high-speed wind stream approaching the limb at some finite angle of attack has a tendency to dislodge the forearm from a surface with which it is in contact. This is due to the generation of stagnation points in the flow which leads to adverse pressure gradients as high as six times the free-stream dynamic pressure. Moreover, when the inviscid analysis is corrected for the effects of flow separation, it is possible to predict the presence of a pressure drag which acts to throw the forearm outward, away from the thorax. Both of these effects increase with angle of attack and they are mildly dependent on the taper of the forearm geometry. It is anticipated that a straightforward extension of the theory to other limbs of the body will shed some light on the general problem of flail injury occurring during high-speed ejections. Author (GRA)

N78-12663# Health Services Mobility Study, New York.
USING TASK DATA IN DIAGNOSTIC RADIOLOGY. VOLUME 2: CURRICULUM OBJECTIVES FOR RADIOLOGIC TECHNOLOGY Final Report
Eleanor Gilpatrick and Christina Gullion May 1977 547 p refs Sponsored in part by Hunter Coll., N. Y., and City Coll. Res. Foundation, N. Y. 2 Vol.
(Contract DL-82-34-69-34)
(PB-270460/9; DLETA-82-34-69-34-RR8-2-Vol-2) Avail: NTIS HC A23/MF A01 CSCL 05I

Design method in radiologic technology and the task analysis results are reported. Volume two contains job-related, behavioral curriculum objectives for the aide, technician, and technologist levels in diagnostic radiology, including patient care and quality assurance. It presents guidelines for using the curriculum objectives for educational ladders to parallel the job ladders recommended in Volume one. The curriculum objectives are in units that can also be arranged in any other sequence. Basic concepts regarding the educational process, the HSMS method, and suggestions for program design and instruction are also included. GRA

N78-12664# Health Services Mobility Study, New York.
USING TASK DATA IN DIAGNOSTIC RADIOLOGY. VOLUME 1. JOB LADDERS: ASSIGNING TASKS TO JOBS Final Report
Eleanor Gilpatrick May 1977 263 p refs Sponsored in part by Hunter Coll., N. Y., and City Coll. Res. Foundation, N. Y. 2 Vol.
(Contract DL-82-34-69-34)
(PB-270459/1; DLETA-82-34-69-34-RR8-1-Vol-1) Avail: NTIS HC A12/MF A01 CSCL 05I

The method and results, the economic rationales for job restructuring, and the use of job ladders; a career ladder program, cost strategies, trainee selection and a mini-manual for performance evaluation using HSMS task data are described. A state practice and quality assurance program, and a check list for the consumer are included. Author

N78-12665# Joint Publications Research Service, Arlington, Va.
TRANSLATIONS ON USSR SCIENCE AND TECHNOLOGY. BIOMEDICAL AND BEHAVIORAL SCIENCES, NO. 14: EFFECTS OF NONIONIZING ELECTROMAGNETIC RADIATION
7 Nov. 1977 93 p refs Transl. into ENGLISH from Russian journals
(JPRS-70101) Avail: NTIS HC A05/MF A01

Information is presented on aerospace medicine, agrotechnology, bionics and bioacoustics, biochemistry, biophysics, environmental ecological problems, food technology, microbiology, epidemiology and immunology, marine biology, military medicine, physiology, public health, toxicology, radiobiology, veterinary medicine, behavioral science, human engineering, psychology, psychiatry and related fields, and scientists and scientific organizations in biomedical fields. Author

N78-12666# Joint Publications Research Service, Arlington, Va.
TRANSLATIONS ON USSR SCIENCE AND TECHNOLOGY: BIOMEDICAL AND BEHAVIORAL SCIENCES, NO. 15
16 Nov. 1977 61 p refs Transl. into ENGLISH from Russian journals
(JPRS-70168) Avail: NTIS HC A04/MF A01
For abstract, see N78-12665.

53 BEHAVIORAL SCIENCES

Includes psychological factors; individual and group behavior; crew training and evaluation; and psychiatric research.

N78-12667 Rochester Univ., N. Y.
PSYCHOPHYSICAL STUDIES OF THE CONTRIBUTION OF CHROMATIC MECHANISMS TO THE VISUAL PERCEPTION OF BORDERS Ph.D. Thesis
Brian Warren Tansley 1976 219 p
Avail: Univ. Microfilms Order No. 77-16253

The contributions of chromatic opponent mechanisms to visual contour perception were investigated using various psychophysical techniques. A description is included of three experiments that demonstrate that the short wavelength sensitive cones do not contribute to the distinctness of borders visible in bipartite fields which have been adjusted to the minimally distinct border point. The specific prediction that border distinctness is related to the activity of the r to g cone response ratio was tested. A quantitative model was developed and applied to data from the investigations. The basic concept was that the r and g cones each signal into a mechanism that is capable of determining the difference in the output of each cone type. This difference reflects the relative response of each cone type to a given photic stimulus. Dissert. Abstr.

N78-12668# Civil Aeromedical Inst., Oklahoma City, Okla.
PERCEIVED ORIENTATION OF A RUNWAY MODEL IN NONPILOTS DURING SIMULATED NIGHT APPROACHES TO LANDING
Henry W. Mertens Jul. 1977 14 p refs
(AD-A044553; FAA-AM-77-12) Avail: NTIS HC A02/MF A01 CSCL 01/2

The effect of varying levels of motion parallax from both radial and vertical motion on perception of the orientation of a runway relative to the ground was investigated. Under simulated nighttime conditions (only runway and approach lighting were visible), 16 nonpilots adjusted the apparent slant of a model runway to make it appear horizontal as the model moved toward them along a 3 degree approach path from a simulated distance of 4.33 to 1.33 nautical miles. Simulated approach speeds of 62 and 125 knots were used. The rate at which the model rotated during slant adjustments varied between 5 degree and 30 degree per minute. The adjusted slant of the runway model with respect to the approach path (generated approach angle) was the dependent variable. The average generated approach angle for 256 trials was 0.5 degree. This consistent and large deviation from 3 degree (which would represent accurate perception) indicates the presence of strong illusions, is in agreement with the documented tendency of pilots to fly low approaches at night, and is explained in terms of the equidistance tendency and/or errors in perceiving the direction of the model in the visual field. The data also suggest that motion parallax in the runway image is neither a reliable nor an effective cue for the safe judgment of glide path at distances greater than 1.33 miles. Author

N78-12669# Civil Aeromedical Inst., Oklahoma City, Okla.
THE EFFECT OF INCREASED MONITORING LOAD ON VIGILANCE PERFORMANCE USING A SIMULATED RADAR DISPLAY
Richard I. Thackray, J. Powell Bailey, and R. Mark Touchstone Jul. 1977 16 p refs
(AD-A044558; FAA-AM-77-18) Avail: NTIS HC A02/MF A01 CSCL 05/9

The extent to which level of target density influences the ability to sustain attention to a complex monitoring task requiring only a detection response to simple stimulus change was examined. The visual display was designed to approximate a futuristic, highly automated air traffic control radar display containing computer-generated alphanumeric symbols. Forty-eight male subjects, equally divided into three groups, were exposed to density levels of 4, 8, or 16 targets. Ten critical stimuli (signals) were randomly presented during each half-hour of the 2-hour session. Detection latency to the critical stimuli in the 16-target condition was significantly greater than latency to the 4- and 8-target conditions. There was no evidence of performance decrement in the two lower density conditions. The 16-target condition showed a significant progressive increase in mean detection latency, which was primarily the result of an increase in long latencies. The hypothesized decline in attention associated with this condition appeared to be independent of any major change in arousal level. Author

54 MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT

Includes human engineering; biotechnology; and space suits and protective clothing.

N78-12670*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SAMPLED DATA ANALYSIS OF A COMPUTER-CONTROLLED MANIPULATOR
B. R. Markiewicz 15 Oct. 1977 40 p ref
(Contract NAS7-100)
(NASA-CR-155272; JPL-Pub-77-66) Avail: NTIS HC A03/MF A01 CSCL 05E

A comprehensive sampled data analysis of a computer-controlled manipulator is presented in terms of root loci for gain selection and transient responses to step input functions. All parameter values and their derivations where applicable were tabulated. The analysis, while quite specific, uses normalized gain parameters, which allows the results to be applied to any similar system regardless of individual hardware parameter values. Author

N78-12671# McDonnell-Douglas Astronautics Co., St. Louis, Mo.
MANUAL CONTROL IN TARGET TRACKING TASKS AS A FUNCTION OF CONTROL TYPE TASK LOADING AND VIBRATION Final Report, 1 Jun. 1976 - 31 May 1977
Thomas G. Drennen, James G. Curtin, and Harold D. Warner 1 Aug. 1977 117 p refs
(Contract N00014-76-C-0883; NR Proj. 196-143)
(AD-A043903; MDC-E1713) Avail: NTIS HC A06/MF A01 CSCL 05/8

An investigation was conducted on the use of fingertip tracking controls which were integrated into an aircraft throttle grip under different levels of task loading and vibration. The experimental variables included two types of control (force and displacement), two levels of task loading (low and high) and four levels of vibration (static, moderate and heavy turbulence and broadband). The low task loading condition required the pilots only to track the displayed targets or to fly the simulated aircraft, while the high task loading condition required simultaneous target tracking and aircraft attitude and airspeed control. The vibrations were random vertical accelerations of 0.11 or 0.35 g(rms) amplitude across the 0.1-20 Hz frequency range. The moderate turbulence condition was 0.11 g(rms) in magnitude with a vibrational response which peaked at 0.2 Hz. The heavy turbulence condition was similar except it had a 0.35 g(rms) intensity. The broadband spectra also had a 0.35 g(rms) intensity but with equal response across the frequency range. In the evaluation, 16 pilots performed the target tracking and aircraft control tasks in a motion base simulator. The dependent measures were pitch, roll and airspeed error for the aircraft control tasks and acquisition time and error, overshoots before acquisition, percent time on target and x-y tracking error for the target tracking tasks. GRA

N78-12672# Human Factors Research, Inc., Goleta, Calif.
FUNCTIONAL REQUIREMENTS AND OTHER DESIGN FEATURES OF A MANNED SYSTEM RESEARCH FACILITY Final Report, Oct. 1976 - Jun. 1977
Gregory V. Bailey, Robert T. Hennessy, and C. Dennis Wylie Aug. 1977 195 p
(Contract N00123-76-C-1245)
(AD-A044234) Avail: NTIS HC A09/MF A01 CSCL 05/8

A study was conducted to describe the functional requirements for the development of a Manned System Research Facility (MSRF) to be located at NPRDC. The MSRF will be a laboratory for the demonstration of and experimentation on advanced concepts of man-machine interaction and the controlled study of operator performance in a system context. The report consists of a section providing an introduction to the MSRF concept, and sections dealing specifically with the recommended MSRF subject work station consoles, computer system, software requirements, voice communications system, physical facility, staffing, and acquisition and development plan. The report contains reviews and/or discussions of manned systems research, display technology, distributed processing systems, computer operating systems, and programming languages. Author (GRA)

N78-12673# Army Environmental Hygiene Agency, Aberdeen Proving Ground, Md.
LASER PROTECTIVE EYEWEAR
David H. Sliney and Del Valle Aug. 1977 18 p
(AD-A044105) Avail: NTIS HC A02/MF A01 CSCL 06/17

Laser eye protection often provides the most important control measure in reducing or eliminating ocular hazards from lasers in the laboratory or downrange in a laser target area in field situations. General information on the design characteristics and important parameters to consider in selecting laser eye protection are provided. A list of commercially available laser eye protectors with manufacturer specifications is provided. Author (GRA)

N78-12674# Desmatics, Inc., State College, Pa.
PREDICTION OF MOTION SICKNESS INCIDENCE: A STATISTICAL EXAMINATION OF THREE APPROACHES

Dennis E. Smith Aug. 1977 27 p refs
(Contract N00014-74-C-0154)
(AD-A044060; TR-102-4) Avail: NTIS HC A03/MF A01 CSCL 06/19

This report summarizes three approaches which have been suggested for predicting motion sickness incidence (MSI) for actual or simulated broadband ship motion. Two of these approaches are based on the results of MSI models developed for pure sinusoidal motion. The third approach, which uses weights derived by least squares, cannot be based directly on these models. Instead, it would be developed empirically from observed MSI in experiments involving broadband motion. Although only a small amount of empirical MSI data exists for motion other than that produced by a single sinusoid, this data provides strong statistical evidence that the two approaches based on the single sinusoid models fail to produce accurate predictions. Statistical judgments about the least squares weighting approach must be reserved until enough empirical data exists to provide an adequate test. Author (GRA)

N78-12675# Army Natick Research and Development Command, Mass. Clothing, Equipment and Materials Engineering Lab.
EVALUATION OF US AIR FORCE SURVIVAL/ARMOR VEST IN US ARMY OH-58 HELICOPTERS Final Report
Thomas H. Judge and Michael B. Kulinski Feb. 1976 58 p refs
(AD-A044842; CEMEL-161; NATICK-TR-7T-3-CEMEL) Avail: NTIS HC A04/MF A01 CSCL 06/17

The USAF developed a Survival/Armor Vest concept. This was coordinated with the DoD Tri Service Committee in Aircrew Body Armor with a complete exchange of development information between the services. Four evaluations: Static, Flight, Body Load and Pressure, and Sizing were conducted and these revealed a number of minor design deficiencies. The material used in the vest construction does not provide sufficient retention of the armor insert and carrier. Lack of retention caused the armor insert to rest on the pilots legs creating leg discomfort. The USAF Survival/Armor Vest requires redesigning to correct the deficiencies presented here. The sizing criteria were also evaluated. New sizing criteria are recommended to improve the sizing.GRA

55 PLANETARY BIOLOGY

Includes exobiology and extraterrestrial life.

No abstracts in this category.

59 MATHEMATICAL AND COMPUTER SCIENCES (GENERAL)

No abstracts in this category.

60 COMPUTER OPERATIONS AND HARDWARE

Includes computer graphics and data processing.

For components see *33 Electronics and Electrical Engineering*.

N78-12676 George Washington Univ., Washington, D. C.
A COMPARATIVE STUDY OF VERY LARGE DATA BASES Ph.D. Thesis
Edward Hill, Jr. 1977 230 p
Avail: Univ. Microfilms Order No. 77-17210

A comparison of methods is provided for organizing very large amounts of stored data called a very large data base to facilitate fast retrieval of desired information on direct access storage devices. The average number of accesses to store and retrieve items on a direct access storage device for hashing methods using chaining with separate lists and linear probing is presented. A new algorithm and performance measures for chaining with coalescing lists are presented. New performance measures are presented for storing and retrieving with a binary search tree and a tree stored on a direct access storage device. Algorithms are presented to perform retrieval, insertion, deletion and the inverted file generation operations for an inverted file. New performance measures are presented for an inverted file. The methods are developed using a component concept. A hybrid method involving components is used for the linked files. Dissert. Abstr.

N78-12677 California Univ., Berkeley.
GENERAL LANGUAGE PROCESSOR: AN ASSOCIATIVE PROCESSOR FOR NATURAL LANGUAGE ANALYSIS Ph.D. Thesis
Rowland Reay Johnson 1976 145 p
Avail: Univ. Microfilms Order No. 77-15723

The general language processor is an interpreter that uses knowledge that is organized at the lexical level to analyze natural language. Basically, the lexicon consists of a set of procedures, one for each lexical item. The GLP interpreter operates the lexical procedures in parallel and provides a mechanism for their interaction that is not based on a control structure. First, a motivation for organizing knowledge at the lexical level is provided by investigating the issues involved in representing knowledge. In particular, the declarative and procedural representations of knowledge are analyzed. A procedural representation that is based on many independent procedures is shown to be desirable. Next, the programming language for the lexical procedures, which is based on the augmented transition network formalism, is presented. Dissert. Abstr.

N78-12678 Purdue Univ., Lafayette, Ind.
A MODEL OF COMPUTER-AIDED DEFINITION AND ANALYSIS OF INFORMATION SYSTEM REQUIREMENTS Ph.D. Thesis
Benn R. Konsynski, Jr. 1976 252 p
Avail: Univ. Microfilms Order No. 77-15432

A formal systems definition model for describing information system requirements is developed. The model evolved from abstraction of information flow in systems. The model, utilizing object, attribute and relation constructs, facilitates a formal procedure for description and analysis of user requirements. System objects are classified into documents, historical data, data definition, process definition, conditional control, operational interfaces, and system parameters. Relations are similarly classified as relating to information flow, system structure, data organization, system dynamics, data manipulation, etc. Relations may be complementary and may exist between relations as well as between objects. Dissert. Abstr.

N78-12679 Rutgers Univ., New Brunswick, N. J.
THE EARLY STAGES OF MACHINE PERCEPTION: AN APPLICATION TO READING MACHINES Ph.D. Thesis
John Christian Wild, Jr. 1977 263 p
Avail: Univ. Microfilms Order No. 77-17576

Those stages of machine perception which occur prior to recognition and which are the basis for the selective attention mechanism are investigated. In the earliest stage of perception, local properties of the visual image are used to measure the microstructure of objects. New window operators, sensitive to the local properties of text, are developed. Adaptive techniques are used to minimize effects due to window size. The regions of response are identified and used to define a map of the visual stimulus. This is accomplished through the use of segmentation techniques on the field of response. A characterization, or profile, for each region in the map is generated by the interference between different fields. The map and profiles provide visual orientation and are the basis for selecting an area for further attention. A number of examples, demonstrating a variety

of possible visual environments for textual material, are processed. Dissert. Abstr.

N78-12680# Illinois Univ., Urbana-Champaign. Coordinated Science Lab.
ANALYSIS OF MEMORY ADDRESSING ARCHITECTURE Ph.D. Thesis
Daniel Wayne Hammerstrom Jul. 1977 149 p refs
(Contract DAAB07-72-C-0259; Grant NSF MCS-73-03488)
(AD-A044313; R-777; UILU-ENG-77-2224) Avail: NTIS HC A07/MF A01 CSCL 09/2

This research investigates the process of generating memory addresses within computer programs and evaluates methods for making that process more efficient. The approach taken here is to separate program execution into a computation process and an addressing process. The addressing process generates the memory reference stream for the computation process (and incidentally for itself as well). The memory reference stream of the computation process is then modeled probabilistically and its information content derived. Several techniques are presented for improving addressing efficiency with standard computer architectures. GRA

N78-12681# Naval Postgraduate School, Monterey, Calif.
AN EXTENDED BASIC COMPILER WITH GRAPHICS INTERFACE FOR THE PDP-11/50 COMPUTER M.S. Thesis
Michael David Robertson Jun. 1977 209 p refs
(AD-A044366) Avail: NTIS HC A10/MF A01 CSCL 09/2

The design and implementation of an extension to the Basic programming language for use on the PDP-11/50 computer system has been described. The implementation consists of a compiler which generates code to be assembled and loaded into the computer system. An interface with C programs in the system library, which allows extended Basic to perform as an extensive graphics language, has been discussed. The design goals, solutions, and recommendations for further expansion of the system have been presented. The compiler was implemented in the C-programming language with the UNIX operating system as supported by the PDP-11/50 at the Naval Postgraduate School Computer Laboratory. Author (GRA)

N78-12682# Computer Corp. of America, Cambridge, Mass.
A DISTRIBUTED DATABASE MANAGEMENT SYSTEM FOR COMMAND AND CONTROL APPLICATIONS Semiannual Technical Report, 1 Jan. - 30 Jun. 1977
30 Jun. 1977 125 p refs
(Contract N00039-77-C-0074)
(AD-A044441; CA-76-06; SATR-1) Avail: NTIS HC A06/MF A01 CSCL 09/4

This report summarizes the first six months of a project entitled, A Distributed Database Management System for Command and Control Applications. The key objective of this effort is to design and implement a distributed database management system called SDD-1 (System for Distributed Databases). SDD-1 will be installed in phases and tested. GRA

N78-12683# Sperry Univac, St. Paul, Minn. Defense Systems Div.
COLOR TERMINAL DEVELOPMENT STUDY Final Report
Aug. 1977 123 p refs
(Contract F30602-76-C-0461)
(AD-A044310; RADC-TR-77-271) Avail: NTIS HC A06/MF A01 CSCL 09/2

A feasibility effort was conducted to determine the difficulties inherent in enhancing an existing dual-screen display terminal with color cathode ray tubes. Two high resolution color CRTs were acquired. Necessary monitor circuitry was modified from the original or developed, including a digital convergence concept. A mock-up (brassboard) was built and demonstration at a 525 TV line standard with text and graphics demonstration software. An Advent color projector was modified to accept high bandwidth color signals from the demonstration terminal. Author (GRA)

N78-12684# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PROCEDURE AND PROGRAM OF THE CALCULATIONS ON TSVM (UBM - DIGITAL COMPUTER) OF TRANSIENT PROCESSES IN LINEAR ELECTRICAL CIRCUITS WITH THE CONCENTRATED PARAMETERS
V. V. Ilinichnin, L. A. Korolev, and L. S. Levin 17 Nov. 1976 28 p refs Transl. into ENGLISH from Tr. Vniie Vses. Nauch. Issled. Inst. Elektroenergetiki, Izd-vo Energiya (Moscow), n. 39, 1971 p 35-45
(AD-A044674; FTD-ID(RS)T-1606-76) Avail: NTIS HC A03/MF A01 CSCL 09/3

Digital computer calculations are reported that utilize concentrated cell elements to analyze transient currents and voltage stresses in electrical circuits. Cell elements of grid networks with distributed parameters are represented by an appropriate replacement scheme that uses cuts of long lines. Author (GRA)

N78-12685# Army Aviation Systems Command, St. Louis, Mo. Advanced Methodology Div.
MINICOMPUTER SYSTEM STUDY Final Report
Mark E. Barkley Jul. 1977 48 p refs
(AD-A044752; USAAVSCOM-TR-77-40) Avail: NTIS HC A03/MF A01 CSCL 09/2

Minicomputers were observed in light of United States Army Aviation Systems Command (AVSCOM), Systems Analysis Office (SAO), Scientific and Engineering (S and E) current and forecasted computer requirements. The SAO computer requirements were isolated based on its present and programmed work load. Commensurate with those computer requirements and the SAO work load, compelling considerations in selecting a minicomputer were amassed and analyzed. That analysis resulted in criteria and a method for selecting the appropriate minicomputer to provide generalized S and E computer support to the United States Army Aviation Research and Development Command (AVRADCOM), and in particular the AVRADCOM Directorate for Plans and Analysis, Systems and Cost Analysis Division. Author (GRA)

N78-12686# Carnegie-Mellon Univ., Pittsburgh, Pa. Dept. of Statistics.
MODELS FOR WORK BACKLOGS AT COMPUTERS THAT TIME-SHARE HETEROGENEOUS USERS Interim Report
John P. Lehoczky and Donald P. Gaver Jul. 1977 42 p refs
(Grant AF-AFOSR-2642-74)
(AD-A044741; TR-132; AFOSR-77-1215TR) Avail: NTIS HC A03/MF A01 CSCL 09/2

A number of repairman-type models useful for describing and evaluating time-sharing computer systems with multitype users are presented and analyzed. Several approximation methods are introduced including one which allows for performance evaluation as a function of the queue discipline. Diffusion approximations are also considered. The accuracy of each of the approximation methods is assessed by numerical methods. Author (GRA)

N78-12687# Massachusetts Inst. of Tech., Cambridge. Lab. for Computer Science.
A CASE STUDY OF INTERMODULE DEPENDENCIES IN A VIRTUAL MEMORY SUBSYSTEM M.S. Thesis
Douglas Hamilton Hunt Dec. 1976 124 p refs Sponsored in part by Honeywell Information Systems, Inc.
(Contract F19628-74-C-0193; ARPA Order 2641)
(AD-A044551; MIT-LCS-TR-174) Avail: NTIS HC A06/MF A01 CSCL 09/2

This thesis describes a virtual memory subsystem structure in which apparent intermodule dependencies can be eliminated. The results reported should aid in the design of sophisticated virtual memory subsystems in the future. Author (GRA)

N78-12688# Honeywell Information Systems, Inc., McLean, Va. Federal Systems Operations.
TRANSACTION PROCESSING OPERATING SYSTEM (TPOS) Final Technical Report, Jul. 1976 - Jul. 1977
Ronald Ewing and John Bielski Aug. 1977 261 p
(Contract F30602-76-C-0277)
(AD-A044612; RADC-TR-77-276) Avail: NTIS HC A12/MF A01 CSCL 09/2

The Transaction Processing Operating System (TPOS) is a specialized system designed to control a subset of the total computer environment, on the Honeywell H6000 architecture, of Transaction Processing Application Programs (TPAPS). The

TPOS system is designed to operate under Release 2/H of the General Comprehensive Operating Supervisor (GCOS), the General Remote Terminal Supervisor (GRTS) on the Network Processing Supervisor (NPS) and in conjunction with the Transaction Processing System (TPS). This report includes the user, site and program logic documentation. In addition, this report indicates specific usage of a monitoring and a debugging capability provided within the TPOS environment. Author (GRA)

N78-12689# Mitre Corp., Bedford, Mass.
GEOGRAPHIC DATA DISPLAY IMPLEMENTATION
D. H. Lehman Jun. 1977 228 p refs
(Contract F19628-77-C-0001)
(AD-A044621; MTR-3349; ESD-TR-77-137) Avail: NTIS HC A11/MF A01 CSCL 09/2

To support automated display of positional intelligence data, detailed geographic background displays are needed over a wide range of scales. The Geographic Data Display System (GDDS) displays geographic data on a raster scan display and allows the user to zoom and translate around a map of Central Europe. As the user zooms in on an area, the area is displayed in greater detail, and geographic features such as rivers, roads, etc., are added to the display. This report outlines the capabilities and design of the GDDS, describes the implementation, and documents the programs. Author (GRA)

N78-12690# Massachusetts Inst. of Tech., Cambridge. Lab. for Computer Science.
HARDWARE ESTIMATION OF A PROCESS' PRIMARY MEMORY REQUIREMENTS B.S. Thesis
David Kenneth Gifford Jan. 1977 59 p refs
(Contract F19628-74-C-0198; ARPA Order 2641)
(AD-A044563; MIT-LCS-TM-81; ESD-TR-77-147) Avail: NTIS HC A04/MF A01 CSCL 09/2

This thesis examines the task of correctly assessing a process primary memory requirements. First, an approximation of each process' primary memory requirements is needed to insure optimal operation of a time shared system. Second, an approximation is required to equitably charge for usage of primary memory, one of the most expensive components of a virtual memory system. Author (GRA)

N78-12691# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.
HARDWARE DESIGN AND CONSTRUCTION OF A MICROPROCESSOR LABORATORY M.S. Thesis - Fla. Univ.
James Harold Hill, Jr. 1976 110 p refs
(AD-A044607; AFIT-CI-77-9) Avail: NTIS HC A06/MF A01 CSCL 09/2

This thesis describes the design and realization of a microprocessor laboratory that provides a capability to train students in computer interfacing, digital design using microprocessors, and software development. Four data transmission interface standards (SDLC, HDLC, CAMAC, GPIB) are discussed followed by a description of the unified bus structure chosen for the University of Florida microprocessor laboratory. Also included is a description of the M6800 microcomputer system used in the laboratory prototype along with details on bus data transfer operations. Author (GRA)

61 COMPUTER PROGRAMMING AND SOFTWARE

Includes computer programs, routines, and algorithms.

N78-12692 Pennsylvania State Univ., University Park.
FAST ALGORITHMS FOR PACKING PROBLEMS Ph.D. Thesis
Joseph Yuk-Tong Leung 1977 169 p
Avail: Univ. Microfilms Order No. 77-17706

Packing a set of objects into a set of physical devices with the objective of optimizing some performance measure is considered. The dual bin packing problem is a model for certain problems of maximizing storage utilization. An abstract definition of the problem is stated where pieces with sizes in the range [1,0] and a set of M is greater than or equal to unit capacity bins, place a maximum number of elements into the bins so that no bin capacity is exceeded. A class of heuristic algorithms is presented, the so-called prefix algorithms, and the performance of an arbitrary prefix algorithm is bound. Three heuristic algorithms are proposed and their worst-case behavior is characterized. Finally, the relative performance among these three algorithms is bound. Dissert. Abstr.

N78-12693# New York Univ., N. Y.
A HIERARCHICAL TECHNIQUE FOR MECHANICAL THEOREM PROVING AND ITS APPLICATION TO PROGRAMMING LANGUAGE DESIGN Ph.D. Thesis
Norman Rubin 1976 176 p
Avail: Univ. Microfilms Order No. 77-16519

A new programming language (named DILEMMA) is described. Based on an extended predicate calculus formalism, it is declarative, highly parallel programming language for Artificial Intelligence applications. The extensions include (1) partial evaluation of expression and predicates, (2) heuristics, and (3) completions. This last feature is a way of selecting and recording information by the use of closed semantic subtrees of partial proofs. An illustration of the expressive power of the language is given by an example which produces proofs for a significant fraction of elementary geometry theorems. The program, which will do constructions if required, is less than 100 lines long. The language is interpreted by a mechanical theorem prover based on coercion. Dissert. Abstr.

N78-12694*# Aerophysics Research Corp., Bellevue, Wash.
PCSYS: THE OPTIMAL DESIGN INTEGRATION SYSTEM PICTURE DRAWING SYSTEM WITH HIDDEN LINE ALGORITHM CAPABILITY FOR AEROSPACE VEHICLE CONFIGURATIONS Final Report
D. S. Hague and J. D. Vanderburg Dec. 1977 121 p refs
(Contract NAS1-12977)
(NASA-CR-2912; ARC-TN-218) Avail: NTIS HC A06/MF A01 CSCL 09B

A vehicle geometric definition based upon quadrilateral surface elements to produce realistic pictures of an aerospace vehicle. The PCSYS programs can be used to visually check geometric data input, monitor geometric perturbations, and to visualize the complex spatial inter-relationships between the internal and external vehicle components. PCSYS has two major component programs. The between program, IMAGE, draws a complex aerospace vehicle pictorial representation based on either an approximate but rapid hidden line algorithm or without any hidden line algorithm. The second program, HIDDEN, draws a vehicle representation using an accurate but time consuming hidden line algorithm. Author

N78-12695# Syracuse Univ., N. Y.
DATA TYPES AS LATTICES: RETRACTIONS, CLOSURES AND PROJECTIONS Interim Report, 11 Jun. 1976 - 31 May 1977
Luis E. Sanchis Griffiss AFB, N. Y. RADC Sep. 1977 32 p refs
(Contract F30602-76-C-0325)
(AD-A044827; RADC-TR-77-291) Avail: NTIS HC A03/MF A01 CSCL 19/2

This paper presents the mathematical principles of lattice theory oriented toward the theory of computation. Notions like representations, retraction, projection, and closure have been previously developed, but the connections between them have not been shown elsewhere. Attempted is a systematic treatment of this lattice theory that involves the definition of data structures. Author (GRA)

N78-12696# Aerospace Corp., El Segundo, Calif. Trajectory Analysis Programming Dept.
COMPUTER SIMULATION FOR SPACE SURVEILLANCE NETWORK EVALUATION Final Report, 1 Dec. 1975 - 15 Jun. 1977
Paul T. Gray 15 Jun. 1977 27 p refs
(Contract F04701-76-C-0077)
(AD-A043966; TR-0077(9320)-4; SAMSO-TR-77-62) Avail: NTIS HC A03/MF A01 CSCL 15/3

The design of computer software for large scale scientific simulations often includes the use of existing programs. The software system described in this report was designed to perform Monte Carlo orbit estimation analysis for a study of large scale, highly complex, sensor networks. A requirement imposed was that two existing computer programs were to be used as integral parts of the simulation. This led to the creation of a software system containing several independent software elements, each devoted to a specific function, rather than a single composite program. A separate executive computer program was designed to perform system execution control and to configure input for each system element. Remote console execution of the software system was implemented to facilitate throughput for the large number of computer runs required for analysis purposes.
Author (GRA)

N78-12697# Brown Univ., Providence, R. I. Div. of Applied Mathematics.
ABDUCTION ALGORITHMS FOR GRAMMAR DISCOVERY
Stefan Shrier Jun. 1977 155 p refs
(Contract N00014-77-C-0248)
(AD-A044442) Avail: NTIS HC A08/MF A01 CSCL 09/2

A model of languages syntax acquisition is formulated as an inference problem: to guess the wiring diagram of an unreliable automaton. A constructive method is developed which solves the grammatical inference problem via an abductory inductive process applied to the sample strings generated by the stochastic automaton whose internal wiring diagram is unavailable for inspection. The right invariant equivalence classes which correspond to the states of the sought-for automaton are established by the training sequence and a teacher. The structural description of strings is found directly without a priori assumptions on the number of states (or lengths of strings).
GRA

N78-12698# Stanford Univ., Calif.
RECENT RESEARCH IN COMPUTER SCIENCE Annual Report, Jul. 1976 - Jun. 1977
John McCarthy, Thomas Binford, Cordell Green, David Luckham, and Zohar Manna Jun. 1977 124 p refs
(Contract MDA903-76-C-0206)
(AD-A044231; SU-STAN-CS-77-624; AIM-301) Avail: NTIS HC A06/MF A01 CSCL 09/2

This report summarizes recent accomplishments in six related areas: basic AI research and formal reasoning, image understanding, mathematical theory of computation, program verification, natural language understanding, and knowledge based Programming.
GRA

N78-12699# Harry Diamond Labs., Adelphi, Md.
AN ASSEMBLY-LANGUAGE DIGITAL DIVISION COMPUTER PROGRAM FOR USE IN PROTON-RECOIL SPECTROSCOPY
Craig R. Heimbach Sep. 1977 13 p refs
(AD-A044103; HDL-TM-77-20) Avail: NTIS HC A02/MF A01 CSCL 09/2

A computer program has been modified to circumvent the need for an analog divider for a neutron-energy spectrometer in use at the Harry Diamond Laboratories. The spectrometer is a proton-recoil system, and some division process is necessary to discriminate against gamma sensitivity of the gas proton-recoil detectors. The program is written in basic machine language for the minicomputer that controls spectrometer operation and collects and analyzes data. Coincident dual-parameter data (energies of recoiling protons and pulse rise times) are acquired by the program. The rise-time pulse-height distribution is divided by the energy distribution before storage in the computer memory. This normalization facilitates subtraction of the unwanted gamma sensitivity of the proton-recoil detectors, particularly at low neutron energies. The elimination of the analog divider improves performance and simplifies the operation of the spectrometer.
Author (GRA)

N78-12700# Rochester Univ., N. Y. Dept. of Computer Science.
RPL, A BCPL-BASED PRODUCTION LANGUAGE SYSTEM
Keith A. Lantz and Clifford B. Meltzer Apr. 1977 56 p refs
(Contract N00014-75-C-1091; Grant NSF MCS-76-10825)
(AD-A044438; TR-15) Avail: NTIS HC A04/MF A01 CSCL 09/2

This report is intended to serve two purposes. First, it should provide the design for a production language. To this end, the Rochester Production Language is discussed, as far as possible, in implementation-independent terms. To provide the reader with a feel for the actual use of production language, salient points of the RPL Translator Writing System are also discussed; in particular, the interface to user-supplied BCPL semantic routines. The reader is expected to have a rudimentary knowledge of production language. Second, this report is meant to serve as a reference manual for the Rochester Production Language. It is not, however, a detailed user's guide to the RPL Translator Writing System.
GRA

N78-12701# Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.
FLEXIBILITY AND EFFICIENCY IN COMPUTER PROGRAM FOR DESIGNING CIRCUITS Ph.D. Thesis
Drew Vincent McDermott Jun. 1977 267 p refs
(Contract N00014-75-C-0643)
(AD-A043964; AI-TR-402) Avail: NTIS HC A12/MF A01 CSCL 09/2

This report is concerned with the problem of achieving flexibility (additivity, modularity) and efficiency (performance, expertise) simultaneously in one AI program. It deals with the domain of elementary electronic circuit design. The proposed solution is to provide a deduction-driven problem solver with built-in control-structure concepts. This problem solver and its knowledge base in the application areas of design and electronics are described. The program embodying it is being used to explore the solution of some modest problems in circuit design. It is concluded that shallow reasoning about problem-solver plans is necessary for flexibility, and can be implemented with reasonable efficiency.
Author (GRA)

N78-12702# Analytical Systems Engineering Corp., Burlington, Mass.
MATHEMATICAL ANALYSIS AND IMPLEMENTING SOFTWARE FOR PHYSICAL AND ENGINEERING DATA Final Report, 27 Apr. 1976 - 26 Apr. 1977
Edward Ziemba, Andre LaCroix, Muriel Hervey, John Crosby, and Joanna Enzmann May 1977 160 p
(Contract F19628-76-C-0203)
(AD-A044040; AFGL-TR-77-0116) Avail: NTIS CSCL 09/2

The purpose of this report is to describe most of the numerical analysis, data analysis and computer programming problems performed under this contract. The problems vary in complexity from straightforward program adaptation to tasks requiring analysis, determining, implementing, and sometimes deriving algorithms best suited to perform the calculations. The problems discussed are done so in summary form. The analysis and programming techniques required are outlined. It should be noted that some of these problems are still being analyzed because of their complexity or continuing nature. Others are active because they were begun shortly before the writing of this report.
Author (GRA)

N78-12703# Rome Air Development Center, Griffiss AFB, N.Y.
A COMPARISON OF SEQUENTIAL AND ASSOCIATIVE COMPUTING OF PRIORITY QUEUES WITH APPLICATIONS TO DISCRETE SIMULATION Final Report. Ph.D. Thesis
Barry M. Landson Aug. 1977 202 p refs
(AD-A044213; RADC-TR-77-221) Avail: NTIS HC A10/MF A01 CSCL 09/2

Over the past fifteen years, a number of authors have studied methods of improving data management in discrete simulation. These methods have dealt with the random access memory. Over the same period, a number of other authors have studied various forms of associative architecture. The following research combines both fields of study to focus on discrete simulation data management. The specific concern is priority queues and time flow mechanisms. The approach used is to specify three forms of associative memories and their associated algorithms and then compare them with a random access memory which uses contemporary algorithms. The following is a summary of the results. The direct algorithmic map-over of random access memory algorithms to associative architecture was unsatisfactory.

The algorithmic procedures had to be reconstituted with parallel processing in mind. Further, the traditional time flow mechanisms could not be used and a new time flow mechanism, called fixed increment minimum value, was developed. With the advent of new algorithmic procedures, the various forms of the associative memories did show distinct processing potential based on parametric values established for the computer models. The advantage or disadvantage of the associative architectures with respect to the random access was most sensitive to the ratio of the memory speeds and the processing width or degree of parallelism in the associative cases. The research indicates that hybrid associative memories are superior to straight associative memories for discrete simulation. GRA

N78-12704# Syracuse Univ., N. Y. Dept. of Electrical and Computer Engineering.

COMPUTER PROGRAMS FOR H-FIELD, E-FIELD, AND COMBINED FIELD SOLUTIONS FOR BODIES OF REVOLUTION Interim Technical Report

Joseph R. Mautz and Roger F. Harrington Griffiss AFB, N. Y. RADC Jun. 1977 55 p refs

(Contract F19628-76-C-0300)

(AD-A044204; TR-2; RADC-TR-77-215) Avail: NTIS HC A04/MF A01 CSCL 09/2

A computer program is given to implement the H-field, E-field, and Combined-field solutions given for a perfectly conducting body of revolution excited by an oblique plane wave incident field. The program consists of several subroutines and a main program. The main program calculates the electric current on the body of revolution and the bistatic scattering cross section per square wavelength. Some examples of computations are given and discussed. Author (GRA)

N78-12705# Southern Methodist Univ., Dallas, Tex.

METHODS FOR MODELLING AND GENERATING PROBABILISTIC COMPONENTS IN DIGITAL COMPUTER SIMULATION WHEN THE STANDARD DISTRIBUTIONS ARE NOT ADEQUATE: A SURVEY

Bruce Schmeiser Aug. 1977 10 p refs

(Contract N00014-77-C-0425)

(AD-A044511; IEOR-77018) Avail: NTIS HC A02/MF A01 CSCL 09/2

Methods of modelling probabilistic components which are not adequately represented by the standard continuous distributions (such as normal, gamma, and Weibull) are surveyed. The methods are categorized as systems of distributions, approximations to the cumulative distribution function, and four-parameter distributions. Emphasis is on generality, determination of appropriate parameter values, and random variate generation. Author (GRA)

N78-12706# Massachusetts Inst. of Tech., Cambridge. Lab. for Computer Science.

A ROBUST ENVIRONMENT FOR PROGRAM DEVELOPMENT M.S. Thesis

Harold Jeffrey Goldberg Feb. 1977 100 p refs Sponsored in part by Honeywell Information Systems, Inc.

(Contract F19628-74-C-0193; ARPA Order 2641)

(AD-A044552; MIT-LCS-TR-175; ESD-TR-77-146) Avail: NTIS HC A05/MF A01 CSCL 09/2

This thesis examines the problems of debugging and preservation of the user programming environment and proposes a scheme by which the program development environment can be protected. In addition, the thesis identifies and discusses, in detail, environments that are needed to control a user's process, and examines error signalling mechanisms, particularly in their use in an environment like the one proposed to solve the inter-procedure interference problem. Author (GRA)

N78-12707# Southern Methodist Univ., Dallas, Tex. Dept. of Industrial Engineering and Operations Research.

REJECTION METHODS FOR BETA VARIATE GENERATION

Bruce Schmeiser and Mohamed A. Shalaby Jul. 1977 36 p refs

(Contract N00014-77-C-0425)

(AD-A044566; IEOR-77014) Avail: NTIS HC A03/MF A01 CSCL 12/1

The computer generation of pseudo-random variates from the beta distribution is discussed. Presented are three exact methods applicable for parameter values p = 1 and q = 1. All three methods use rejection from regions defined by the location of the points of inflexion. The methods differ in the amounts of set-up required, with higher set-up times generally resulting in lower marginal generation times. Generation times are compared to three methods in current use. Over a wide range of parameter values marginal generation times are reduced about 50%. Substantial set-up time savings and moderate marginal time savings are obtained. GRA

N78-12708# Stanford Univ., Calif. Systems Optimization Lab.

NUMERICAL ASPECTS OF TRAJECTORY ALGORITHMS FOR NONLINEARLY CONSTRAINED OPTIMIZATION

Walter Murray and Margaret H. Wright Nov. 1976 14 p refs (Contracts N00014-75-C-0865; E(04-3)-326; Grant NSF DCR-75-04544)

(AD-A044903; SU-SOL-76-29) Avail: NTIS HC A02/MF A01 CSCL 12/1

This paper discusses two algorithms for nonlinearly constrained optimization. These algorithms -- the penalty and barrier trajectory algorithms -- are based on an examination of the trajectories of approach to the solution that characterize the quadratic penalty function and the logarithmic barrier function, respectively. Although closely related in principle, the two algorithms display important differences in their implementation as well as in the properties of the generated iterates. The discussion will emphasize the numerical aspects of implementation of the trajectory algorithms, with particular attention to the choice of reliable methods for carrying out the required computations. Author (GRA)

N78-12709# Rome Air Development Center, Griffiss AFB, N.Y.

A STATISTICS COLLECTION PACKAGE FOR THE JOVIAL J3 PROGRAMMING LANGUAGE Progress Report, Jul. 1974 - Dec. 1976

Robert E. Stover Sep. 1977 44 p

(AD-A044947; RADC-TR-77-293) Avail: NTIS HC A03/MF A01 CSCL 09/2

This report describes a software package developed in-house by RADC to measure counts, averages, and percentages relative to the usage of constructs and features of the JOVIAL J3 high order language by programmers. The numbers of occurrences of certain language features are obtained by processing the input JOVIAL J3 sources program in a manner similar to that employed by the front end of a compiler. This data is then used to calculate other quantities, averages, and percentages. Hash coding of identifiers in the input program and any associated compools, and a symbol table in which information about these identifiers is recorded are used to assist in the statistics collection process. This statistics collector is expected to be a valuable tool in the development of JOVIAL J3 and other programming languages by providing guidance relative to (1) more effective methods of programming, (2) implementation of compilers with greater efficiency, and (3) possible language changes. This report also includes a summary of the syntax, semantics, and computer system interface errors made by the implementor in the process of development of the software package. The visibility provided by this information is expected to increase understanding of the nature, causes, and methods of avoidance of software errors. Author (GRA)

N78-12710# California Univ., Santa Cruz. Information Sciences.

A LOGIC-BASED PROGRAMMING METHODOLOGY

Sharon Sickel Mar. 1977 11 p refs

(Contract N00014-76-C-0681)

(AD-A045231; TR-77-8-001) Avail: NTIS HC A02/MF A01 CSCL 09/2

This paper describes a method of program construction that combines some contributions in structured programming, program verification and program synthesis. This method has a start-to-finish continuity within mathematical logic. Author (GRA)

N78-12711# Stanford Univ., Calif. Optimization Lab.

A SUBSTITUTE INVERSE FOR THE BASIS OF A STAIRCASE STRUCTURE LINEAR PROGRAM

Richard D. Wollmer Dec. 1976 27 p refs
(Contract N00014-75-C-0865; Grant NSF DCR-75-04544)
(AD-A044904; SU-SOL-76-31) Avail: NTIS HC A03/MF A01
CSCL 12/1

A method is presented for computing a substitute inverse for linear programs with a staircase structure. Two methods are presented for updating the substitute inverse, both of which consist of updating some, but not all of the T smaller inverses. The first, a pivoting method, required appending one or more columns to the smaller inverse and pivoting on the appended columns. The second required adding one of the dyad matrices to the smaller inverses. Computational efficiency of both methods can be tested to a large degree using standard linear programming codes. Author (GRA)

N78-12712# Stanford Univ., Calif. Systems Optimization Lab.

THE DESIGN AND STRUCTURE OF A FORTRAN PROGRAM LIBRARY FOR OPTIMIZATION

Philip E. Gill, Walter Murray, Susan M. Picken, and Margaret H. Wright Apr. 1977 70 p refs
(Contract N00014-75-C-0865; EY-76-S-03-0326; Grant NSF MCS-76-20019)
(AD-A044905; SU-SOL-77-7) Avail: NTIS HC A04/MF A01
CSCL 09/2

This paper discusses in substantial detail the design principles and structure of an existing Fortran program library whose primary application is to solve optimization problems. Such a discussion not only helps to clarify the scope of application for potential users of the library, but also is useful for workers on other software projects. The fundamental objectives of the present library have been to produce sound, careful implementations of reliable methods that represent the state of the art in numerical optimization. The general implications of these overall design aims are presented, as well as specific instances of the results of decisions to include particular desirable features.
Author (GRA)

N78-12713# Stanford Univ., Calif. Systems Optimization Lab.

DISCOVERING HIDDEN TOTALLY LEONTIEF SUBSTITUTION SYSTEMS

George B. Dantzig Jun. 1977 8 p refs
(Contracts N00014-75-C-0267; N00014-75-C-0865; E(04-3)-326; Grants NSF MCS-76-81259; NSF MCS-76-22019; NR Proj. 047-064; NR Proj. 047-143)
(AD-A044907; SU-SOL-77-17) Avail: NTIS HC A02/MF A01
CSCL 12/1

In an earlier work, necessary and sufficient conditions were stated for the equivalence of a given linear program with a totally Leontief substitution system. This paper presents a constructive procedure for determining the existence and evaluating (when it does exist) the non-singular matrix that transforms the L.P. into a member of the substitution class.GRA

N78-12714# Stanford Univ., Calif. Systems Optimization Lab.

FUNDAMENTALS OF QUADRATIC PROGRAMMING AND LINEAR COMPLEMENTARITY

Richard W. Cottle Aug. 1977 30 p refs Presented at the NATO Advanced Study Inst. on Eng., Waterloo Univ., Ontario, 2 - 12 Aug. 1977
(Contracts F44620-74-C-0079; N00014-75-C-0267)
(AD-A044909; SU-SOL-77-21) Avail: NTIS HC A03/MF A01
CSCL 12/1

The fundamental theory and algorithms of quadratic programming and linear complementarity are presented in expository form. Computational experience is reviewed. Author (GRA)

N78-12715# Stanford Univ., Calif. Dept. of Operations Research.

A GENERALIZATION OF THE FRANK-WOLFE THEOREM

Andre F. Perold Jul. 1977 22 p refs
(Contract N00014-75-C-0267; Grant NSF MCS-76-81259)
(AD-A044910; SU-TR-77-18) Avail: NTIS HC A02/MF A01
CSCL 12/1

The Frank-Wolfe Theorem states that a quadratic function, bounded below on a nonempty polyhedral convex set, attains its infinity. This paper gives sufficient conditions under which a function either attains its infinity on a nonempty polyhedral convex set or is unbounded below on some halfline of that set. Quadratic functions are shown to satisfy these sufficient conditions.
Author (GRA)

N78-12716# Stanford Univ., Calif. Dept. of Operations Research.

A LEAST ELEMENT THEORY OF SOLVING LINEAR COMPLEMENTARITY PROBLEMS AS LINEAR PROGRAMS

Richard W. Cottle and Tong-Shi Pang Dec. 1976 41 p refs
(Contract N00014-75-C-0267; Grant NSF MCS-71-03341)
(AD-A044912; SU-TR-76-30) Avail: NTIS HC A03/MF A01
CSCL 12/1

A previous report established a least-element interpretation to Mangasarian's theory of formulating some linear complementarity problems as linear programs. The present report extends the previous analysis to a more general class of linear complementarity problems investigated by Mangasarian. The purposes are (1) to demonstrate how solutions to these problems can be generated from least elements of polyhedral sets and (2) to investigate how these least-element solutions are related to the solutions obtained by the linear programming approach as proposed by Mangasarian. GRA

N78-12717# Stanford Univ., Calif. Dept. of Operations Research.

INTERIOR PATH METHODS FOR HEURISTIC INTEGER PROGRAMMING PROCEDURES

Bruce H. Faaland and Frederick S. Hillier Feb. 1977 40 p refs Prepared in Cooperation with Stanford Univ., Calif.
(Contracts N00014-76-C-0418; DAAC29-74-C-0034)
(AD-A044913; SU-TR-73; SOL-77-14) Avail: NTIS HC A03/MF A01 CSCL 12/1

This paper considers heuristic procedures for general mixed integer linear programming with inequality constraints. It focuses on the question of how to most effectively initialize such procedures by constructing an interior path from which to search for good feasible solutions. These paths lead from an optimal solution for the corresponding linear programming problem i.e., deleting integrality restrictions into the interior of the feasible region for this problem. Previous methods for constructing linear paths of this kind are analyzed from a statistical viewpoint, which motivates a promising new method. These methods are then extended to piecewise linear paths in order to improve the direction of search in certain cases where constraints that are not binding on the optimal linear programming solution become particularly relevant. Computational experience is reported. Author (GRA)

N78-12718# Stanford Univ., Calif. Dept. of Operations Research.

ALGORITHMIC EQUIVALENCE IN QUADRATIC PROGRAMMING. 1: A LEAST-DISTANCE PROGRAMMING PROBLEM

Richard W. Cottle and Arthur Djang Oct. 1976 68 p refs
(Contract N00014-76-C-0267; Grant NSF MC5-71-03341)
(AD-A044959; SU-TR-76-26-1) Avail: NTIS HC A04/MF A01 CSCL 12/1

It is demonstrated that Wolfe's algorithm for finding the point of smallest Euclidean norm in a given convex polytope generates the same sequence of feasible points as does the van de Panne-Whinston symmetric algorithm applied to the associated quadratic programming problem. Furthermore, it is shown how the latter algorithm may be simplified for application to problems of this type. Author (GRA)

N78-12719# Honeywell Information Systems, Inc., McLean, Va.

WWMCCS ADP STANDARD CLEAR MEMORY/MAGNETIC STORAGE UTILITY STRUCTURED PROGRAMMING EVALUATION TECHNICAL REPORT Final Report, 29 Mar. - 20 Jun. 1977

Jeff Karas, Bob Hickey, and Don Mackeller 20 Jun. 1977 49 p refs
(Contract DCA100-73-C-0055)
(AD-A044634; CCTC-WAD-TR-121-77) Avail: NTIS

HC A03/MF A01 CSCL 09/2

The Clear Memory Utility (CMU) Structured Programming Evaluation Technical Report examines Structured Programming development techniques used during the development of a stand-alone, mini-operating system utility which clears all magnetic storage of the Honeywell Series 6000 computer between periods of classified processing. The effects of the use of the Chief Programmer Team and top-down design, construction and implementation on productivity, reliability and verifiability are examined. Author (GRA)

N78-12720# Naval Postgraduate School, Monterey, Calif.
PARALLEL PROCESSING OF RECURSIVE FUNCTIONS M.S. Thesis
Franklin Burkhead Jun. 1977 89 p refs
(AD-A044473) Avail: NTIS HC A05/MF A01 CSCL 09/2

Algorithms defined as recursive functions, such as in pure LISP, are shown to have structure sufficient to distinguish between processes which must be executed in sequence and processes which may be executed in parallel. An interpreter program is presented for executing LISP programs and simultaneously computing the number of processors needed at each step of program execution in order to achieve optimum parallel processing. Sample program runs are presented to show speed-up ratios between strictly sequential and optimally parallel executions. A possible hardware organization for a parallel processing system derived from the interpreter program is presented. Author (GRA)

N78-12721# Naval Postgraduate School, Monterey, Calif.
AN INTERACTIVE, INCREMENTAL ASSEMBLY LANGUAGE PROCESSOR FOR THE INTEL 8080 M.S. Thesis
John L. Cuzzocrea and Michael Charles Thomas Jun. 1977 75 p refs
(AD-A044476) Avail: NTIS HC A04/MF A01 CSCL 09/2

The design and implementation of an interactive, incremental assembly system on the INTEL 8080-based microcomputer has been described. Instead of requiring separate editing, assembling and debugging steps, the system allows entry, translation and error checking simultaneously. The implementation is comprised of an integrated set of modules which assemble and execute the source code. The design goals, solutions, and recommendations for further expansion of the system have been presented. The system was implemented in PL/M for use in the diskette-based environment. Author (GRA)

N78-12722# Stanford Research Inst., Menlo Park, Calif.
HIERARCHICAL REPRESENTATION OF THREE-DIMENSIONAL OBJECTS Final Report
Gerald J. Agin Mar. 1977 47 p refs
(Contract N00014-71-C-0294)
(AD-A044542) Avail: NTIS HC A03/MF A01 CSCL 09/2

Many different approaches have been investigated for the computer representation of three-dimensional shapes. Most of them lack characteristics that would facilitate man machine communication using semantic, graphic and visual means. This report describes a formal method for describing shapes that have desirable characteristics along these lines. The method uses generalized cylinders to characterize the primitives of the representation and hierarchical assemblages of primitives. A set of computer programs is described that translates formal descriptions of objects into polyhedral models and line drawings. A scanning range finder is used to obtain three-dimensional information about a scene. Then a set of computer programs characterized cones, cylinders, and rectangular solids in the image. The method is manually guided, and requires much operator interaction, but has the potential for extension to a useful system for interactive design, or for formation of the core of a three-dimensional vision system. Author (GRA)

N78-12723# System Development Corp., Santa Monica, Calif.
KNOWLEDGE-BASED SYSTEMS: A TUTORIAL
J. A. Barnett and M. I. Bernstein 30 Jun. 1977 291 p refs
(Contract MDA904-76-C-0343)
(AD-A044883; SDC-TM-(L)-5903/000/00) Avail: NTIS HC A12/MF A01 CSCL 09/2

This report surveys recent and current work in interactive knowledge-based systems (KBS), defining and explaining KBS concepts and technology. Its purpose is to give those who may be interested in the application of such systems a means of assessing their present potential use. It explores both the capabilities and the limitations of KBS technology as they are observable and predictable in existing systems, and provides references and a bibliography that will permit those who want to further explore this topic on their own. GRA

N78-12724# Doty Associates, Rockville, Md.
SOFTWARE COST ESTIMATION STUDY. VOLUME 2: GUIDELINES FOR IMPROVED SOFTWARE COST ESTIMATING Final Technical Report, 23 Feb. 1976 - 23 Feb. 1977
D. L. Doty, P. J. Nelson, and Kenneth R. Stewart Griffiss AFB, N. Y. RADC Aug. 1977 148 p
(Contract F30602-76-C-0182)
(AD-A044609; TR-151-Vol-2; RADC-TR-77-220-Vol-2) Avail: NTIS HC A07/MF A01 CSCL 09/2

This report contains guidelines for developing estimates of computer software cost. Consideration is first given to the initial program estimate which is often made with a paucity of supportive data. Adjustments are presented for modifying the estimate given the availability of additional data. Procedures are presented for assessing the affordability of the resulting estimates. Emphasis is placed on developing a conservative but reasonable best estimate for purposes of program budgeting. Separate consideration is given to steps that should be taken to bring the program in at or below budget. Frequently recurring problems are summarized in their time-phased order of occurrence. Author (GRA)

62 COMPUTER SYSTEMS

Includes computer networks.

N78-12725 California Univ., Berkeley.
PARAMETRIC NETWORK FLOW PROBLEMS Ph.D. Thesis
Janet Ellen Somers 1976 163 p
Avail: Univ. Microfilms Order No. 77-15864

The max-flow problem in a network with k parametric capacities and the min-cost circulation problem in a network with k parametric capacities or costs are studied. In the parametric max-flow problem when all lower capacities are equal to zero, the max-flow value is obtained as an explicit function of the parametric capacities in terms of the max-flow values to 2 sup k closely-related max-flow problems on the same graph. A formula is given for a max-flow as a convex combination, depending on the parametric capacities, of maxflows in those 2 k problems. Detailed analyses for cases k = 1 and 2 are given. In the parametric max-flow problem with non-zero lower bound capacities feasibility is a problem. This problem is solved by describing explicitly the region of parameter vectors for which the problem is feasible in terms of max-flow values to 2 sub k problems in a related transshipment network. This region is in general an unbounded convex polyhedral set of dimension k with at most 2 sup k -1 facets. Dissert. Abstr.

N78-12726# Texas Univ., Austin.
A COMPUTATIONAL ANALYSIS OF ALTERNATIVE ALGORITHMS AND LABELING TECHNIQUES FOR FINDING SHORTEST PATH TREES
Robert Dial, Fred Glover, David Karney, and Darwin Klingman Apr. 1977 66 p refs
(Contracts N00014-75-C-0569; N00014-75-C-0616)
(AD-A044118; CCS-291) Avail: NTIS HC A04/MF A01 CSCL 09/2

This paper examines different algorithms for calculating the shortest path from one node to all other nodes in a network. More specifically, we seek to advance the state-of-the-art of computer implementation technology for such algorithms and the problems they solve by examining the effect of innovative computer science list structures and labeling techniques on algorithmic performance. The study shows that the procedures examined indeed exert a powerful influence on solution efficiency, with the identity of the best dependent upon the topology of the network and the range of the arc distance coefficients. The study further discloses that the shortest path algorithm previously documented as the most efficient is dominated for all problem

structures by the new methods, which are sometimes an order of magnitude faster. Author (GRA)

N78-12727# Massachusetts Inst. of Tech., Cambridge. Lab. for Computer Science.
A MULTI-PROCESS DESIGN OF A PAGING SYSTEM
Andrew R. Huber Dec. 1976 148 p refs Sponsored in part by Honeywell Information Systems, Inc.
(Contract F19628-74-C-0193; ARPA Order 2641)
(AD-A044547; MIT-LCS-TR-171; ESO-TR-77-144) Avail: NTIS HC A07/MF A01 CSCL 09/2

This thesis presents a design for a paging system that may be used to implement a virtual memory on a large scale, demand paged computer utility. A model for such a computer system with a multi-level, hierarchical memory system is presented. The functional requirements of a paging system for such a model are discussed, with emphasis on the parallelism inherent in the algorithms used to implement the memory management functions. A complete, multi-process design is presented for the model system. The design incorporates two system processes, each of which manages one level of the multi-level memory, being responsible for the paging system functions for that memory. These processes may execute in parallel with each other and with user processes. The multi-process design is shown to have significant advantages over conventional designs in terms of simplicity, modularity, system security, and system growth and adaptability. An actual test implementation on the Multics system was carried out to validate the proposed design. Author (GRA)

N78-12728# Maryland Univ., College Park.
THE DISTRIBUTED COMPUTER NETWORK PROJECT Final Report
David L. Mills Jul. 1977 27 p refs
(Contract N00014-67-A-0239-0032)
(AD-A044727; TR-555) Avail: NTIS HC A03/MF A01 CSCL 09/2

This report summarizes the work done during the last year of the Distributed Computer Network (DCN) Project. The accomplishments during this period include further refinement of the operating systems and compilers, development of automatic fault-recovery and resource-assignment facilities and re-evaluation of certain concepts indigent to the DCN architectural design. Author (GRA)

63 CYBERNETICS

Includes feedback and control theory.

For related information see also *54 Man/System Technology and Life Support.*

N78-12729 Iowa State Univ. of Science and Technology, Ames.
OPTIMAL AND SUBOPTIMAL NUMERICAL SOLUTIONS TO A CLASS OF OPTIMAL CONTROL PROBLEMS WITH APPLICATIONS TO SAILPLANE DYNAMICS Ph.D. Thesis
Lawrence James Genalo 1977 162 p
Avail: Univ. Microfilms Order No. 77-16956

Several minimum time dynamic sailplane thermalling problems are investigated through the use of optimal control theory. The optimal control problems encountered have the entire initial and terminal states specified and equal. The range between thermals, the strength of the thermals, and the thermal model are varied and the results are examined. Both optimal and suboptimal numerical solutions are presented. The conjugate gradient and quasilinearization algorithms are used to obtain the numerical optimal solutions. Cost and accuracy comparisons are made between these two methods. The linear/quadratic approximation of the optimal control problem is also solved as is a linearized approximation of the two-point boundary value problem. The linear/quadratic approximation requires a singular arc solution. Dissert. Abstr.

N78-12730 North Carolina Univ., Chapel Hill.
NUMERICAL SOLUTION OF NEARLY DECOMPOSABLE QUEUING NETWORKS Ph.D. Thesis
Raymond Lewis Zarling 1976 98 p
Avail: Univ. Microfilms Order No. 77-17386

The applicability of an aggregation technique of Simon and Ando to the problem of finding the equilibrium probability vector of a finite, nearly decomposable Markov chain is investigated. The method involves using the solution of a nearly equal, decomposable system together with a limited knowledge of the small couplings between classes of the original chain to approximate the solution. Of central concern is the utility of the technique for an analysis of computer system models for specific levels of coupling, rather than for asymptotic analysis as the coupling tends to zero. Dissert. Abstr.

N78-12731 Washington Univ., Seattle.
ACCESSIBILITY AND STABILITY THEORY OF NONLINEAR CONTROL SYSTEMS Ph.D. Thesis
Nicholas Kalouptsidis 1976 155 p
Avail: Univ. Microfilms Order No. 77-16730

The accessibility and stability aspects of nonlinear control systems are discussed. In many cases (optimal control, controllability theory) an estimate of the size of the attainable sets is desirable. This estimate is provided by certain manifolds that contain the attainable sets in a minimal way. These manifolds, whose existence has been established in the analytic case, are shown here to exist in the C to the infinite power case and furthermore are described via the action of a certain group of diffeomorphisms. Subsequently, these results are applied to derive certain properties of smooth control systems. Utilizing the orbits structure associated with a control system, and working only with the topological dynamics of the system, a new approach to stability theory of control systems is developed. For any such theory it is of main importance to know the stability behavior in the vicinity of the controllability subspace under consideration. Dissert. Abstr.

N78-12732# California Univ., Los Angeles. Dept. of System Science.
APPROXIMATE CONTROLLABILITY AND WEAK STABILIZABILITY Interim Report
Claude D. Benchimol Jul. 1977 7 p refs
(Grant AF-AFOSR-2492-73)
(AD-A044732; AFOSR-77-1161TR) Avail: NTIS HC A02/MF A01 CSCL 12/1

A necessary and sufficient condition for the stabilizability of semigroups which are similar to contractions is given in terms of the approximate controllability of the infinite dimensional system derivative of $x = Ax + Bu$. Author

N78-12733# Yale Univ., New Haven, Conn. Systems and Information Sciences.
AN UNSTABLE DYNAMICAL SYSTEM ASSOCIATED WITH MODEL REFERENCE ADAPTIVE CONTROL
A. Feuer, B. R. Barmish, and A. S. Morse May 1977 9 p ref
(Contract AF-AFOSR-77-3176; AF Proj. 2304)
(AD-A044725; S/IS-7702; AFOSR-77-1172TR) Avail: NTIS HC A02/MF A01 CSCL 12/2

It is shown that a certain system of differential equations of importance to the proof of stability of the adaptive system proposed in (1), admit unbounded solutions. The implication of this result is that a much more elaborate argument than heretofore thought necessary is required to prove that the adaptive system of (1) is stable, if it is stable at all. Author (GRA)

N78-12734# Arizona Univ., Tucson. Dept. of Mathematics.
SINGULAR PERTURBATIONS AND OPTIMAL CONTROL
R. E. OMalley, Jr. Sep. 1977 32 p refs Presented at Conf. on Mathematical Control Theory, Canberra, Australia, 23 Aug. - 2 Sep. 1977
(Contract N00014-76-C-0326)
(AD-A044833; TR-18) Avail: NTIS HC A03/MF A01 CSCL 12/2

These lecture notes are intended to provide an elementary account of some of the recent mathematical effort in applying singular perturbations theory to optimal control problems, to demonstrate the practical importance of this asymptotic technique to current engineering studies, and to suggest several open problems needing further research. GRA

N78-12735# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
USE OF THE OPTIMAL CONTROL MODEL IN THE DESIGN OF MOTION CUE EXPERIMENTS

Andrew M. Junker and William H. Levison Aug. 1977 18 p refs Presented at the 13th Ann. Conf. on Manual Control, Cambridge, Mass., 15-17 Jun. 1977
(Contract F33615-77-C-0506; AF Proj. 2312)
(AD-A044841; AMRL-TR-77-67) Avail: NTIS HC A02/MF A01 CSCL 12/2

An experiment is presented in which effects of roll motions on human operator performance were investigated. The motion cues considered were the result of commanded vehicle motion and vehicle disturbances. An optimal control pilot-vehicle model was used in the design of the experiment and to predict system performance before executing the experiment. The model predictions and experimental results are compared. Seventy-eight percent of the model predictions are compared. The high correlation between model predictions and system performance indicate the usefulness of the predictive model for experimental design and for prediction of pilot performance influenced by motion cues. Author (GRA)

N78-12736# Dialog Systems, Inc., Cambridge, Mass.
KEY WORD CLASSIFICATION Final Technical Report
S. L. Moshier, P. N. Leiby, and R. E. Smith Griffiss AFB, N. Y. RADC Aug. 1977 149 p
(Contract F30602-75-C-0171)
(AD-A044605; RADC-TR-77-122) Avail: NTIS HC A07/MF A01 CSCL 17/2

This report summarizes the development of a real-time key word recognition. The basic objectives for the system were the ability to detect one or more key words in continuous speech, independent of the speaker. By concentrating half-syllable sized utterances in sequence to detect the occurrence of a spoken work, good temporal registration was obtained and with good recognition results. On a limited number of talkers (about ten) results of 90% - 95% detection and 4-6 false alarms per hour were obtained. When the data base is increased to approximately fifty talkers, the results obtained are 85% detection and 20-25 false alarms per hour. The techniques and hardware developed under this effort appear very promising. Improvements appear feasible with only modest changes. Author (GRA)

64 NUMERICAL ANALYSIS

Includes iteration, difference equations, and numerical approximation.

N78-12737 California Univ., Los Angeles.
SOME ALGORITHMS FOR COVARIANCE STRUCTURE ANALYSIS Ph.D. Thesis
Sik Yum Lee 1977 140 p
Avail: Univ. Microfilms Order No. 77-17230

Algorithms were investigated as means of obtaining the weighted least squares and maximum likelihood estimators of Theta, which is the vector of unknown parameters in a general convariance structure model Sigma (Theta). The Gauss-Newton, Newton-Raphson, Scoring, Fletcher-Powell and Fletcher-Reeves algorithms were applied. Comparisons were made in terms of computer time, cost, accuracy of the estimates and the appropriateness of the standard error estimates. The Gauss-Newton algorithm was recommended. Dissert. Abstr.

N78-12738 New York Univ., N. Y.
SOME FINITE DIMENSIONAL INTEGRABLE SYSTEMS Ph.D. Thesis
Mark Alan Adler 1976 72 p
Avail: Univ. Microfilms Order No. 77-16460

Integrable Hamiltonian systems are discussed that are solved by interpreting the equations of motion as deformation equations for matrix functions whose spectra remain fixed as the system evolves in time, leading both to integrals of the motion, and a description of the solution. It is shown that for all these systems symmetric polynomials turn out to be rational in exponentials, or polynomials in at most n exponentials. Dissert. Abstr.

N78-12739 California Univ., Berkeley.
THE STRUCTURE OF CROSSED PRODUCT C^*-ALGEBRAS Ph.D. Thesis
Philip Palmer Green, III 1976 138 p
Avail: Univ. Microfilms Order No. 77-15701

The structure of the crossed product C^*-algebra $C^*(G,A)$ associated to a system (G,A) consisting of a locally compact group G acting by $*$-automorphisms on a C^*-algebra A is studied. The structure theory of these algebras has two aspects: The global theory, which aims at a complete characterization of the algebra; and the local theory, which has the more modest goal of determining the primitive ideal and trace structure of the algebra. Dissert. Abstr.

N78-12740 California Univ., Santa Barbara.
ISOMETRIES OF MATRIX ALGEBRAS Ph.D. Thesis
Robert Dale Grone 1976 17 p
Avail: Univ. Microfilms Order No. 77-17323

Let T be a linear transformation n on M sub m,n,(F), the algebra of m x n matrices over the field F. Let delta be a subset of M sub m,n(F) and let f be a scalar valued function defined on M sub m,n(F). The general problems of determining the subsemigroup of linear transformation on M sub m,n(C) are discussed which satisfy: T(delta) each point belongs to delta. T(delta) is a subset of delta; or f(T(A)) coincides f(A), all A belongs to the set M sub m,n(C). Dissert. Abstr.

N78-12741 Southwestern Louisiana Univ., Lafayette.
A HEURISTIC APPROACH TO FINDING ROOTS OF A POLYNOMIAL OF ANY DEGREE Ph.D. Thesis
Jack Robert Sanders 1976 142 p
Avail: Univ. Microfilms Order No. 77-13175

The design, implementation, and evaluation of a heuristic scheme which determines the roots of a polynomial in one variable of arbitrary degree is discussed. Root solving algorithms were tested and evaluated from the points of view (1) number of roots found; (2) accuracy, (3) number of algorithm iterations; and (4) the influence of zero-valued coefficients. As a result of the testing and evaluation phase, heuristic evaluation functions were developed for the global methods of solution and the local methods of solution. The combinations of the methods governed by Heuristic Function I and Heuristic Function II produced a scheme for finding refined roots of input polynomials. In addition, specific user options were included in the overall scheme. A learning routine was incorporated into the scheme in order to optimize the root solving process based on previous experience. Finally, the learning scheme and the overall heuristic scheme were evaluated in order to determine learning ability and problem solving ability and efficiency. Dissert. Abstr.

N78-12742 California Univ., Los Angeles.
A RESOURCE DIRECTIVE DECOMPOSITION METHOD FOR MATHEMATICAL PROGRAMMING BASED ON LAGRANGEAN THEORY Ph.D. Thesis
Francisco Walter Molina 1977 164 p
Avail: Univ. Microfilms Order No. 77-16193

Decomposition methods used to solve resource allocation theories were examined. A mathematically rigorous allocation theory of broad practical implications was presented simultaneously with a simple and ready to implement decomposition method. Decomposition methods were reviewed along with general concepts of theoretical importance. The coordination scheme was based on Lagrange multipliers of the subproblems, interpreted as efficiencies with which the different subsystems utilized shared resources. Resources were taken from the less efficient subsystems and given to the more efficient ones, in an iterative process that ended when the efficiencies equalized. Dissert. Abstr.

N78-12743# Pennsylvania State Univ., University Park. Coll. of Business Administration.
APPROXIMATIONS OF MULTIATTRIBUTE UTILITY FUNCTIONS Interim Report
Peter C. Fishburn Sep. 1977 32 p refs
(Contract N00014-75-C-0857; NR Proj. 047-112)
(AD-A044733; TR-25) Avail: NTIS HC A03/MF A01 CSCL 12/2

This report extends a previously developed approximation theory for two-attribute cardinal utility functions to utility functions defined on three or more attributes. If focuses on the simple

additive and multiplicative approximations along with several other elementary forms. The purpose of the report is to assess how well simple approximations can describe more complex utility functions on multiattribute outcome spaces. Author (GRA)

N78-12744# Massachusetts Inst. of Tech., Cambridge. Center for Information Systems Research.

SOLVING DECOMPOSITION PROBLEMS: ALTERNATIVE TECHNIQUES AND DESCRIPTION OF SUPPORTING TOOLS

Rafael C. Andreu Sep. 1977 54 p refs
(Contract N00039-77-C-0255)
(AD-A044759; CISR-P010-01-02; CISR-TR-2) Avail: NTIS HC A04/MF A01 CSCL 12/1

An interactive software system specially designed to solve the kind of set decomposition problems that arise in the investigation of a systematic approach for the early phases of the system development process is presented. Traditional cluster analytic algorithms are available in the system, as well as other more recent approaches. Author (GRA)

N78-12745# Texas Univ., Austin. Center for Numerical Analysis.

EXTRAPOLATION WITH SPLINE-COLLOCATION METHODS FOR TWO-POINT BOUNDARY-VALUE PROBLEMS 2: C2-CUBICS WITH DETAILED RESULTS

James W. Daniel and Andrew J. Martin Aug. 1977 78 p
(Contract N00014-76-C-0275)
(AD-A044736; CNA-125) Avail: NTIS HC A05/MF A01 CSCL 12/1

The methodology is very briefly described and then numerical results are presented for an implementation of a smooth-cubic-spline-collocation procedure accelerated via iterated deferred corrections to obtain approximate solutions, accurate to a prescribed tolerance, of two-point boundary-value problems for second-order scalar ordinary differential equations. The results are similar to those obtained via a less generally applicable finite-difference-oriented code described elsewhere which competes well with the best codes available. Author (GRA)

N78-12746# Naval Surface Weapons Center, White Oak, Md. White Oak Lab.

THE OPERATOR COMPACT IMPLICIT METHOD FOR PARABOLIC EQUATIONS

Melvyn Ciment, Stephen H. Leventhal, and Bernard C. Weinberg 7 Apr. 1977 59 p refs
(AD-A044564; NSWC/WOL/TR-77-29) Avail: NTIS HC A04/MF A01 CSCL 12/1

This paper attempts to trace out the broad characteristics of a class of higher order finite difference schemes which are applicable to the solution of parabolic partial differential equations associated with viscous fluid flow problems. The basic method developed here uses the approach of the compact implicit techniques applied to the full spatial operator. The resulting spatial approximation, referred to here as the operator compact implicit method can be implemented with a variety of temporal integration schemes. In particular, a simple factorization technique is employed to resolve higher space dimension problems in terms of simple tridiagonal systems. The operator compact implicit method is compared to standard techniques and to some of the newer compact implicit methods. Stability characteristics, computational efficiency and the results of numerical experiments are discussed. GRA

N78-12747# Rice Univ., Houston, Tex. Aero-astronautics Group.

MODIFICATIONS AND ALTERNATIVES TO THE CUBIC INTERPOLATION PROCESS FOR ONE-DIMENSIONAL SEARCH Interim Report

A. Miele, F. Bonardo, and S. Gonzalez 1976 39 p refs
(Grants AF-AFOSR-3075-76; NSF MCS-76-21657)
(AD-A044572; AAR-135) Avail: NTIS HC A03/MF A01 CSCL 12/1

The numerical solution of the problem of minimizing a unimodal function f(alpha) is considered, where alpha is a scalar. Two modifications of the cubic interpolation process are presented, so as to improve the robustness of the method and force the process to converge in a reasonable number of iterations, even in pathological cases. Modification M1 includes the nonoptional bisection of the interval of interpolation at each iteration of the process. Modification M2 includes the optional bisection of the interval of interpolation. Twenty-nine numerical examples are presented. The numerical results show that both modifications of the cubic interpolation process improve the robustness of the process. They also show the promising characteristics of the proposed alternative. Therefore, the one-dimensional search schemes described have potential interest for those minimization algorithms which depend critically on the precise selection of the stepsize, namely, conjugate gradient methods. Author (GRA)

N78-12748# Air Force Systems Command, Wright-Patterson AFB, Ohio. Translation Div.

ASYMPTOTIC EFFECTIVENESS OF GENERALIZED V-FILTERS

V. T. Dolgochub and M. B. Sverdlik 30 Mar. 1977 12 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Radioelektron. (USSR), v. 15, no. 11, Nov. 1972 p 1400-1401
(AD-A044779; FTD-ID(RS)I-0392-77) Avail: NTIS HC A02/MF A01 CSCL 12/1

Mathematical filters, Band pass filters, Delay lines, Weighting functions, Ambiguity, Signal to noise ratio, Translations, USSR NU filters, Smoothing, Pulse response Asymptotic Effectiveness of Generalized V- Filters-- Translation. GRA

N78-12749# Chicago Univ., Ill.

A THEOREM ON HOMOTOPY PATHS

C. B. Garcia and F. J. Gould Jun. 1977 23 p refs
(Contract N00014-75-C-0495; Grant NSF ENG-76-81058)
(AD-A044666) Avail: NTIS HC A02/MF A01 CSCL 12/1

A theorem is proved which is directly related to and motivated by a result on piecewise linear functions. This theorem relates the signs of the derivatives to the signs of the determinants of submatrices of the Jacobian matrix N prime. Applications to solving nonlinear equations are given. Author

N78-12750# Maryland Univ., College Park. Dept. of Computer Science.

SENSITIVITY COEFFICIENTS FOR THE EFFECTS OF ERRORS IN THE INDEPENDENT VARIABLES IN A LINEAR REGRESSION

G. W. Stewart Sep. 1977 10 p refs
(Contract N00014-76-C-0391)
(AD-A044817; TR-571) Avail: NTIS HC A02/MF A01 CSCL 12/1

This paper is concerned with errors in the observed values of the independent variables of a linear regression. Sensitivity coefficients are proposed to measure the effects of these errors and show that they can easily be computed from quantities ordinarily calculated in performing the regression. GRA

N78-12751# Wisconsin Univ., Madison. Mathematics Research Center.

PERTURBATION METHODS FOR THE SOLUTION OF LINEAR PROBLEMS

L. B. Rall Jun. 1977 36 p refs
(Contract DAAG29-75-C-0024)
(AD-A044829; MRC-TSR-1754) Avail: NTIS HC A03/MF A01 CSCL 12/1

Linear problems of central interest in numerical analysis are the solution of linear equations, the construction of the inverse or a generalized inverse of a linear operator, finding the eigenvalues and eigenvectors of a linear operator, and linear programming. A survey is made of methods which apply if the data of a solved linear problem is perturbed by operators and vectors of small norm (analytic perturbation), or by operators of finite rank and vectors belonging to a finite-dimensional subspace (algebraic perturbation). Perturbation methods may be used to extend the theory of linear problems, to obtain economy of effort in the solution of perturbed problems, and to estimate errors due to inaccurate data and computation. Author (GRA)

N78-12752# Cornell Univ., Ithaca, N. Y. School of Operations Research and Industrial Engineering.

DECOMPOSITIONS, SHELLINGS, AND DIAMETERS OF SIMPLICIAL COMPLEXES AND CONVEX POLYHEDRA

John Scott Provan Aug. 1977 131 p refs

(Contract N00014-75-C-0678; Grant NSF MPS-75-02034) (AD-A045050; TR-354) Avail: NTIS HC A07/MF A01 CSCL 12/1

Simplicial complexes are studied in their role dual to convex polyhedra, in particular, with respect to shellability and diameters. The concept of k-decomposability is presented which both insures shellability and limits the diameter of a simplicial complex. k-decomposability is studied in relation to standard techniques used in polyhedral theory, and with respect to topological properties of simplicial complexes. Author (GRA)

65 STATISTICS AND PROBABILITY

Includes data sampling and smoothing; Monte Carlo method; and stochastic processes.

N78-12753 North Carolina Univ., Chapel Hill.
GENERALIZED RANK TESTS FOR PROGRESSIVE CENSORING PROCEDURES Ph.D. Thesis
Hiranmay Majumdar 1976 147 p
Avail: Univ. Microfilms Order No. 77-17345

Progressively censored tests for grouped and ungrouped data were proposed and their asymptotic properties were studied. It was shown that under suitable regularity conditions, distributions of the proposed statistics converge weakly to those of some functionals of the standard Brownian motion process under the null hypothesis and to those of the drifted Brownian motion process under contiguous alternatives. As the available statistical tools do not provide the necessary analytical expressions for the exact null distribution of these processes, their empirical distributions were derived through simulation. Dissert. Abstr.

N78-12754 Kentucky Univ., Lexington.
A STUDY OF ORTHOGONAL TRANSFORMATIONS AND THEIR APPLICATIONS TO STATISTICS Ph.D. Thesis
Samuel Greene Lindle 1976 128 p
Avail: Univ. Microfilms Order No. 77-15956

Certain properties concerning sums and products of the simplest real orthogonal matrices are developed, symmetric and asymmetric two by two orthogonal matrices. Similar properties are then extended to symmetric and asymmetric plane rotations. A special type of orthogonal matrix called an elementary reflector (House-holder transformation) is used. A three-step procedure for graphical representational of non-orthogonal data is developed in order to aid in the interpretation of such data. A FORTRAN program was written to do the calculations and plotting needed for this procedure. Dissert. Abstr.

N78-12755 Kentucky Univ., Lexington.
A BAYESIAN CLASSIFICATION OF SAMPLES INTO MULTINOMIAL POPULATIONS Ph.D. Thesis
David Benjamin Marx 1976 159 p
Avail: Univ. Microfilms Order No. 77-15960

The compound multiple decision problem of classifying many samples each into one of several multinomial populations is studied from a subjective Bayesian decision theoretic point of view. Choices of loss functions are discussed with heavy emphasis on an additive loss function and global zero-one loss function. The choice of the prior probability of the classification parameter, gamma, is of major importance here. The classification parameter is discussed in detail when either independent priors on the components of gamma are applicable or when an exchangeable prior is applicable. The choice of an exchangeable prior on gamma introduces symmetry as well as dependency in the classification procedure. The dependency of the procedure is such that each sample has some influence upon the classification of every other sample. It is shown that independent and identically distributed priors on the components of gamma is simply a limiting case of the exchangeable prior. Dissert. Abstr.

N78-12756 California Univ., Berkeley.
ON THE ASYMPTOTIC THEORY OF STATISTICAL EXPERIMENTS AND SOME OF ITS APPLICATIONS Ph.D. Thesis
Mohamed Walid Moussatat 1976 201 p
Avail: Univ. Microfilms Order No. 77-15794

Some aspects of the theory of experiments in the infinite dimensional case are developed and the results are applied to special problems. Considered are abstract Wiener spaces. Gaussian shift experiments are defined when the parameters are in a Hilbert space. Local asymptotic normal experiments are studied by the limiting distribution, under contiguous alternatives, of the linear process which appears in these experiments; and the existence of a modification which convergence in deficiency of these experiments to Gaussian shift experiments, uniformly over compacts is shown. Next the local asymptotic sufficiency of the linear process is established. Dissert. Abstr.

N78-12757 Kansas Univ., Lawrence.
SOME NEW RESULTS IN NONLINEAR ESTIMATION AND STOCHASTIC CONTROL Ph.D. Thesis
Jang-Yao Liang 1976 255 p
Avail: Univ. Microfilms Order No. 77-16347

The optimal Gauss type quadrature formulae method in the sense of Sard is used to implement the nonlinear filter, and the stochastic version of Merriam's parametric expansion method for deterministic system is employed to approximate the future expected cost-to-go equations for both the open-loop-optimal-feedback and the closed-loop policies. A generalized certainty equivalence class of controls which broadens the class relative to previous knowledge is derived. The generalization of certainty equivalence is with assumptions on the noises and the initial state. These have been assumed independent but are assumed to be statistically correlated here. Dissert. Abstr.

N78-12758# Pennsylvania State Univ., University Park. Coll. of Business Administration.
STOCHASTIC DOMINANCE WITHOUT TRANSITIVE PREFERENCES Interim Report
Peter C. Fishburn Sep. 1977 23 p refs
(Contract N00014-75-C-0857; NR Proj. 047-112)
(AD-A044685; TR-24) Avail: NTIS HC A02/MF A01 CSCL 12/2

Traditional definitions of stochastic dominance for decision analysis assume that the decision agent's preference-or-indifference relation on outcomes of risky decisions is transitive. This report proposes a stochastic dominance relation for the comparison of risky decisions that is applicable to any complete and reflexive preference-or-indifference relation, or to any asymmetric preference relation. The new dominance relation possesses a number of intuitively desirable properties and is equivalent to the usual stochastic dominance relation when preferences are transitive. Author (GRA)

N78-12759# North Carolina Univ., Chapel Hill. Dept. of Statistics.
ON THE RATE DISTORTION FUNCTIONS OF MEMORYLESS SOURCES UNDER A MAGNITUDE-ERROR CRITERION
Hoi M. Leung and Stamatis Cambanis 1977 38 p refs
(Grant AF-AFOSR-2796-7)
(AD-A044755; AFOSR-77-1194TR) Avail: NTIS HC A03/MF A01 CSCL 12/1

The evaluation of and bounds for the rate distortion functions of independent and identically distributed (i.i.d.) sources under a magnitude-error criterion were considered. By refining the ingeneous approach of Tan and Yao the rate distortion functions of larger classes of i.i.d. sources were evaluated explicity and the families of lower bounds for arbitrary i.i.d. sources were obtained. GRA

N78-12760# Illinois Univ., Urbana-Champaign. Coordinated Science Lab.
SENSITIVITY APPROACH TO THE DUAL CONTROL PROBLEM Interim Report
Consuelo S. Padilla (Venezuelan Inst. of Sci. Res.) and J. B. Cruz, Jr. Aug. 1977 7 p refs
(Contract DAAB07-72-C-0259; Grant AF-AFOSR-2570-73)
(AD-A044731; AFOSR-77-1171TR) Avail: NTIS HC A02/MF A01 CSCL 12/2

A stochastic adaptive control problem that incorporates estimation cost considerations is formulated. A sensitivity index is introduced to represent the estimation cost. The control effort on estimation is distributed according to the accuracy required to achieve a given control objective when there is a bound on the estimation cost. The effect of the control on the sensitivity

functions is used to influence the future uncertainties of the system. A dynamic feedback control algorithm is proposed that explicitly takes into account the accuracy of estimation and distributes the estimation effort in an optimal fashion.
Author (GRA)

N78-12761# Ballistic Research Labs., Aberdeen Proving Ground, Md.
ON THE DISTRIBUTION OF THE PRODUCT OF TWO GAMMA VARIATES Final Report
Palmer R. Schlegel Sep. 1977 9 p refs
(AD-A044886; BRL-MR-2783) Avail: NTIS HC A02/MF A01 CSCL 12/1

In this paper Mellin tranforms are used to determine the distribution of the product of two random variables, each of which is distributed by gamma functions and parameterized by an integer n. Furthermore, a recursive relationship is developed with respect to the parameter n to facilitate the evaluation of the resulting distribution. Author (GRA)

N78-12762# Purdue Univ., Lafayette, Ind. Dept. of Statistics.
ON SELECTION RULES FOR FINITE MIXTURES OF DISTRIBUTIONS
Shanti S. Gupta and Wen-Tao Huang Aug. 1977 21 p refs
(Contract N00014-75-C-0455)
(AD-A045106; Mimeo-Ser-504) Avail: NTIS HC A02/MF A01 CSCL 12/1

A class of consistent selection procedures is proposed for the selection of the t largest proportions of finite mixture of distributions. The approach is based on the indifference zone formulation. Some asymptotic optimal properties are shown to hold. For the special case of m = 2, the number of components in each of k mixture populations, some results of the asymptotic relative efficiency are obtained. Author (GRA)

N78-12763# Purdue Univ., Lafayette, Ind. Dept. of Statistics.
ON SELECTION OF POPULATIONS CLOSE TO A CONTROL OR STANDARD
Shanti S. Gupta and Ashok K. Singh Sep. 1977 19 p refs
(Contract N00014-75-C-0455)
(AD-A044892; Mimeo-Ser-508) Avail: NTIS HC A02/MF A01 CSCL 12/1

In many treatment vs. control situations the experimenter is interested in the populations which are 'close' to control rather than the populations which are 'better' than control. In this paper the problem of selection of all populations which are 'close' to a given standard or control population has been considered from the subset selection approach, and some Bayes and classical rules are investigated. Author (GRA)

N78-12764# Stanford Univ., Calif. Dept. of Statistics.
DISCRIMINATION BETWEEN STATIONARY GAUSSIAN PROCESSES, LARGE SAMPLE RESULTS
Will Gersch Jan. 1977 21 p refs
(Contract N00014-75-C-0442; Grant NSF ENG-74-09883)
(AD-A044893; SU-TR-30) Avail: NTIS HC A02/MF A01 CSCL 12/1

The structure of the asymptotic log-likelihood ratio decision procedure for the discrimination of alternative stationary zero mean multivariate Gaussian processes is developed. The log-likelihood ratio statistic is shown to be asymptotically normally distributed. New time and frequency domain formulas for the conditional mean (The Kullback-Liebler information measure) and variance of the log-likelihood ratio statistic under the alternative hypotheses are given and the probability of misclassification is shown to be bounded exponentially with n, the number of observations. Author (GRA)

N78-12765# Stanford Univ., Calif. Dept. of Statistics.
GOODNESS-OF-FIT FOR THE EXTREME VALUE DISTRIBUTION
Michael A. Stephens 18 Jul. 1977 19 p refs
(Contract N00014-76-C-0475; Grant DAAG29-77-G-0031)
(AD-A044900; SU-TR-247) HC A02/MF A01 CSCL 12/1

This paper presents goodness-of-fit tests for the extreme value distribution, based on the EDF statistics W-squared, U-squared and A-squared. Asymptotic percentage points are given for each of the three statistics, for the three cases where one or both of the parameters of the distribution must be estimated from the data. Slight modifications of the calculated statistics are given to enable the points to be used with finite samples.
Author (GRA)

N78-12766# Stanford Univ., Calif. Dept. of Statistics.
INFORMATION ANALYSIS OF LINEAR INTERACTIONS IN CONTINGENCY TABLES
S. Kullback and O. V. Gokhale 15 Aug. 1977 29 p refs
(Contract N00014-76-C-0475; Grant DAAG29-77-G-0031)
(AD-A044902; SI-TR-249; SU-TR-9) Avail: NTIS HC A03/MF A01 CSCL 12/1

The use of the minimum discrimination information (MDI) approach in studying null hypotheses of no interactions on a linear scale in contingency tables of one response many factors type is illustrated. Quadratic approximations to the M.D.I. statistic are related to Wald-type statistics and Neyman's modified chi-square. Follow up analyses when the null hypothesis is not satisfied are illustrated. Author (GRA)

N78-12767# Stanford Univ., Calif. Dept. of Statistics.
RANDOM SPACE FILLING AND MOMENTS OF COVERAGE IN GEOMETRICAL PROBABILITY
A. Siegel 4 Apr. 1977 35 p refs
(Contract N00014-76-C-0475)
(AD-A044983; SU-TR-244) Avail: NTIS HC A03/MF A01 CSCL 12/1

The moments of the random proportion of a fixed set that are covered by a random set (moments of coverage) are shown to converge under very general conditions to the probability that the fixed set is almost everywhere covered by the random set. Moments and coverage probabilities are calculated for several cases of random arcs of random sizes on a circle. One tends to increase coverage by choosing an arc length distribution that is less peaked at its expectation when that expectation is constrained at a particular value. Author (GRA)

N78-12768# Stanford Univ., Calif. Dept. of Statistics.
ESTIMATION OF PARAMETERS OF ZERO-ONE PROCESSES BY INTERNAL SAMPLING: AN ADAPTIVE STRATEGY
M. Brown, Herbert Solomon, and M. A. Stephens 28 Feb. 1977 25 p ref
(Contract N00014-76-C-0475; Grant DAAG29-77-G-0031)
(AD-A044984; SU-TR-241; TR-1) Avail: NTIS HC A02/MF A01 CSCL 12/1

In a previous paper, the problem of estimating the parameters was considered giving the mean time in each stage, for a two-stage Poisson process, when sampling was permitted only at equal intervals. It was impossible to get good results unless the intervals were small. Now an adaptive strategy is proposed in which the interval is successively halved until a suitable stage is reached; then all samples can be combined to give estimates. The strategy is examined by Monte Carlo methods, and it is shown to give a considerable improvement over the one-stage method. Figures are given to illustrate the results; they can be used also to improve estimates and give confidence intervals. A technique is proposed to give an approximate confidence ellipse for the two parameters, which appears to work well for the ranges considered. GRA

N78-12769# California Univ., Los Angeles. School of Engineering and Applied Science.
NEW LIGHT ON WEIBULL THEORY Progress Report, 1977 - 1978
S. B. Batdorf and G. H. Sines Sep. 1977 21 p refs
(Contract N00014-76-C-0445)
(AD-A044832; UCLA-ENG-7762) Avail: NTIS HC A02/MF A01 CSCL 20/11

In 1939 Weibull applied the weakest link theory to the interpretation of the variability of fracture stress of nominally identical specimens. He attributed this variation to the presence of sources of weakness, or flaws, that were given a strength, but no other physical properties. Accordingly, his theory rests primarily on the statistics of extreme values. It is now generally believed that the most important sources of weakness are

microcracks. Thus an ideal statistical theory of fracture must take into account of fracture mechanics and material microstructure. Present paper outlines recent progress along these lines, and shows how the resulting more fundamental theories reduce to Weibull theory when certain simplifying assumptions are made. Author (GRA)

N78-12770# Chicago Univ., Ill. Dept. of Statistics.
METHODS IN PROBABILITY AND STATISTICAL INFERENCE Progress Report, 15 Jun. 1976 - 14 Jun. 1977
Michael D. Perlman Mar. 1977 32 p refs
(Contract EY-76-S-02-2751)
(COO-2751-2) Avail: NTIS HC A03/MF A01

Research activities of the Department of Statistics, University of Chicago, are reviewed. Individual projects were carried out in the following eight areas: statistical computing-approximations to statistical tables and functions; numerical computation of boundary crossing probabilities for Brownian motion and related stochastic pocesses; probabilistic methods in statistical mechanics; combining independent tests of significance; small sample efficiencies of tests and estimates; improved procedures for simultaneous estimation and testing of many correlations; statistical computing and improved regression methods and comparison of several populations. Brief summaries of these projects are given, along with other administrative information. Author (ERA)

66 SYSTEMS ANALYSIS

Includes mathematical modeling; network analysis; and operations research.

N78-12771 North Carolina Univ., Chapel Hill.
QUANTILE ESTIMATION METHODS FOR DISCRETE EVENT SIMULATIONS OF REGENERATIVE SYSTEMS Ph.D. Thesis
Andrew Frederick Seila 1976 251 p
Avail: Univ. Microfilms Order No. 77-17372

A method proposed by D. L. Inglehart for estimating quantiles in regenerative process is outlined. The method of averaging (MA) estimator is evaluated as an alternative to Inglehart's method. It is shown that the method of averaging is conceptually simpler and easier to implement than Inglehart's method, and under appropriate circumstances, the estimator has the same asymptotic normal distribution as Inglehart's estimator. Simulation results using the .9-quantile of waiting time in the M/M/1 queue show that the MA estimator is seriously biased; however, when the jackknife technique is applied, the method of averaging performs comparably with Inglehart's method. The method of averaging appears to be preferable for estimating quantiles in discrete event simulations of regenerative systems. Dissert. Abstr.

N78-12772 Connecticut Univ., Storrs.
THE APPLICATION OF MATRIX PENCIL THEORY TO LINEAR MULTIVARIABLE SYSTEMS Ph.D. Thesis
Louis Francis Godbout, Jr. 1977 150 p
Avail: Univ. Microfilms Order No. 77-16709

The basic concepts of matrix pencils are considered along with the development of computational algorithms for transforming regular and singular pencils to their respective canonical forms. Furthermore, a modified singular pencil canonical form is presented which has extensive applications in linear control theory. Some applications of regular pencils to linear systems are discussed with the majority of the discussion pointed at a method for deriving state space models. The generalized eigenvalue problem is also treated. Using singular pencil theory the constant output feedback system is studied. New bounds on how many coefficients of the closed-loop characteristics equation can be independently controlled by the output feedback gain matrix are given. In addition, some coefficients which can be controlled by the gain matrix are identified. A direct optimization approach to the output feedback problem is also presented. Dissert. Abstr.

N78-12773 California Univ., Los Angeles.
OPERATOR MODELS OF INFINITE DIMENSIONAL SYSTEMS Ph.D. Thesis
David James Hedberg 1977 105 p
Avail: Univ. Microfilms Order No. 77-16172

The relationships between operator models of contraction operators on Hilbert spaces and models of linear infinite dimensional state space systems were studied. The Nagy-Foias theory of harmonic analysis of contraction operators is shown to provide a means of realizing discrete time linear systems from their input-output transfer operators. The state variable operators (A, B, C, D) obtained in the realization are expressed in terms of the compression of a shift operator. Particular classes of systems are identified on the basis of contraction operator type. The controllability, observability, and asymptotic stability properties of systems in these classes are characterized. Continuous time linear infinite dimensional systems are studied by means of an equivalent input-output function on the complex unit disk. By association of a companion discrete time system, well defined continuous time state space realizations are obtained. Dissert. Abstr.

N78-12774 Washington Univ., Seattle.
ALGEBRAIC ASPECTS OF DISCRETE-TIME BILINEAR SYSTEMS AND POLYNOMIAL SYSTEMS Ph.D. Thesis
Shigeki Nonoyama 1976 148 p
Avail: Univ. Microfilms Order No. 77-16732

A realization algorithm and an abstract realization theory for bilinear systems, and controllability of polynomial systems, were investigated. From the external descriptions algorithms are obtained for the construction of finite-dimensional, constant, discrete-time, internally bilinear state space models with unknown initial states. Both the homogeneous and the inhomogeneous bilinear systems are treated. In both cases explicit existence criteria for minimal realizations as well as the state space isomorphism theorems are given. For homogeneous bilinear systems the approach is based on the formation of a suitable infinite Hankel matrix from the input-output maps. For the inhomogeneous bilinear systems the approach is to convert the inhomogeneous bilinear systems to homogeneous bilinear systems and then to perform manifold realization. Dissert. Abstr.

N78-12775 California Univ., Los Angeles.
OPTIMAL CONTROL AND ESTIMATION OF SINGULAR DYNAMIC SYSTEMS Ph.D. Thesis
Katsuo Yonezawa 1977 124 p
Avail: Univ. Microfilms Order No. 77-16203

Introducing projection operators, optimal control and estimation theory is generalized for singular dynamic systems where a measurement noise covariance matrix is nonnegative definite (stochastic observer), and/or a weighting matrix on a control vector for quadratic criteria is nonnegative definite (singular optimal control). A unified method to solve the optimal control and/or estimation problems for linear continuous singular dynamic systems is developed with this new approach to express the singularity in terms of projection operators which produce significant results. Dissert. Abstr.

N78-12776 California Univ., Los Angeles.
A METHODOLOGY FOR THE ECONOMIC REGULATION OF STRATOSPHERIC FLIGHT Ph.D. Thesis
Guo-An Pan 1977 153 p
Avail: Univ. Microfilms Order No. 77-17235

Engine emissions from aircraft flying in the stratosphere may cause an average global reduction of ozone which produces undesirable environmental effects. A methodology for the economic regulation of stratospheric flights is developed. Two methods only are considered for controlling the environmental effects with altitude and load factor regulations. A model is employed to find optimal regulations on the global route network so that total regulation costs of stratospheric flight are minimized. A computational algorithm to find an optimal solution of the approximated model is developed. Dissert. Abstr.

N78-12777 Texas Technological Univ., Lubbock.
INTEGRATION METHODS IN SYSTEM ANALYSIS Ph.D. Thesis
Ching-Tsai Pan 1976 71 p
Avail: Univ. Microfilms Order No. 77-16037

An integration method is proposed for solving multiple solutions of a class of nonlinear equation f(x) = 0, where f =

(f1, f2) is a continuously differentiable function from R squared into itself. A similar version in the complex domain is described too. The solution curves of either f sub 1 = 0 (Re g(z) = 0) in the complex domain, where g(z) is a complex polynomial with complex variable (z) or f sub 2 = 0 (Im g(z) = 0) are traced to search for all solutions. Comprehensive and integrated theoretical bases for the method are detailed. Applications to nonlinear AC-resistive network analysis, the plotting of root loci of linear feedback control systems and the determination of all eigenvalues of a linear time invariant system are also discussed.
Dissert. Abstr.

N78-12778# California Univ., Los Angeles. Graduate School of Management.
ON THE ANALYSIS OF COMPLEX, SOFTLY DEFINED PROBLEMS
Bennet P. Lientz Sep. 1977 21 p refs
(Contract N00014-75-C-0266)
(AD-A044846) Avail: NTIS HC A02/MF A01 CSCL 12/2

Softly defined problems are probelms in which constraints and objectives are imprecise and fuzzy in the sense of the concept of fuzzy set theory. A concept of fuzzy worth is formulated. An algorithm is presented which extracts the most worthy alternatives. A method is developed for obtaining all efficients solutions in the neighborhood of several most worthy alternatives. The approach is interpreted in terms of utility theory. An example of the selection of performance measures of a mobile communication system is given.
Author (GRA)

N78-12779# National Range Operations Directorate, White Sands Missile Range, N. Mex. Analysis and Computation Div.
NEW GRADIENT TECHNIQUES FOR TRACES OF FUNCTIONS OF RECTANGULAR MATRICES AND THEIR PSEUDO-INVERSES
James S. Pappas and Oren N. Dalton Sep. 1977 46 p
(AD-A044808; ACD-61-77) Avail: NTIS HC A03/MF A01 CSCL 12/2

The generalized inverse is of increasing importance for estimation and optimization in modern systems theory, because it both simplifies many problems and reveals underlying structures of theoretical importance. Optimization, using the gradient of the trace of products of matrix valued functions, including the generalized inverse, are presented in a novel state-space setting. A number of functions of such products of matrices, including general formulas, are derived for the first time to our knowledge. Tables of a number of them are given with some applications in the fields of estimation and optimization.
Author (GRA)

N78-12780# Cornell Univ., Ithaca, N. Y. School of Operations Research and Industrial Engineering.
ON GAME THEORY AND COALITION FORMATION
Prakash P. Shenoy Jul. 1977 145 p refs
(Contract N00014-75-C-0678; Grant NSF MPS-75-02024)
(AD-A045049; TR-342) Avail: NTIS HC A07/MF A01 CSCL 12/2

The theory of n-person cooperative games presented by von Neumann and Morgenstern is a mathematical theory of coalition behavior. A fundamental problem posed in game theory is to determine what outcomes are likely to occur if a game is played by rational players. Given an n-person cooperative game and assuming rational behavior, it is natural to inquire which of the possible coalitions can be expected to form and what will be the final payoffs to each of the players. However, most of the research in game theory has been concerned explicitly with predicting player's payoff and only implicitly (if at all) with predicting which coalitions shall form. In this investigation, the primary emphasis is on the first aspect of coalition behavior, namely the formation of coalitions.
GRA

N78-12781# Stanford Univ., Calif. Dept. of Operations Research.
A COMPLETE IMPORTANCE RANKING FOR COMPONENTS OF BINARY COHERENT SYSTEMS, WITH EXTENSIONS TO MULTI-STATE SYSTEMS
David A. Butler 1 Aug. 1977 43 p refs
(Contract N00014-75-C-0561)
(AD-A044895; SU-TR-183) Avail: NTIS HC A03/MF A01 CSCL 12/2

Given a system composed of many components, a question of considerable interest is which components are most relevant or crucial to the proper functioning of the system. In response to this question, a number of importance measures and rankings have been proposed. This paper investigates a new ranking and compares it to existing rankings, principally the ranking induced by the Birnbaum reliability importance measure. The new ranking is based upon minimal cuts and provides a complete ordering of all the system's components relative to their importance to the system reliability. This ranking has three main points in its favor: (1) the calculations involved require only readily obtainable information; (2) the calculations are usually quite simple; and (3) the ranking is designed for use with systems consisting of highly reliable components, the most common case. The final section of the paper deals with extensions of importance measures and rankings to systems in which both the system and its components may be in any of a finite number of states. Many of the results about importance measures and rankings for binary systems established in preceding sections are shown to extend to the more sophisticated multi-state systems. Also, the multi-state importance measures and rankings are shown to be decomposable into a number of sub-importance measures and rankings.
Author (GRA)

N78-12782# Stanford Univ., Calif. Dept. of Operations Research.
ON RENEWAL DECISIONS
C. Derman (Columbia Univ., N. Y.), G. J. Lieberman, and S. Ross (Univ. of Calif., Berkeley) 8 Aug. 1977 17 p refs
(Contracts N00014-75-C-0561; N00014-75-C-0620; N00014-68-A-0200-1036; DAHC04-74-C-0226)
(AD-A044896; SU-TR-184) Avail: NTIS HC A02/MF A01 CSCL 12/2

A system must operate for T units of time. A certain component is essential for the system to be operative. When it fails it must be replaced. However, there are n types of components that can be used; some types are more costly but tend to last longer -- others are cheaper but are not likely to last as long. The general problem is to assign the initial component type and all subsequent replacements so as to minimize the expected cost of providing an operative component for the life of the system. Intuition would suggest that when the system is relatively new and a replacement is necessary it would be rational to use an expensive type providing the additional component life bought is worth the extra price; similarly when the system is old, an inexpensive type should be used. Consideration of this problem is intended to make this intuition more precise and to explore under what conditions it is, in fact, valid. The problem can be viewed as one in discrete time parameter negative dynamic programming.
GRA

67 THEORETICAL MATHEMATICS

Includes topology and number theory.

N78-12783 New York Univ., N. Y.
VECTOR, FIELDS ON MANIFOLDS Ph.D. Thesis
Leon Karp 1976 56 p
Avail: Univ. Microfilms Order No. 77-16494

A number of problems related to topological and geometric conditions satisfied by manifolds that admit vector fields of special types was studied. In particular, it is shown that manifolds satisfying certain explicit topological and geometric conditions admit vanishing killing fields for any metric. It is shown, also, that if a compact complex manifold admits a nonvanishing holomorphic vector field, then its Hodge numbers satisfy certain conditions. If the manifold is of a restricted class then stronger conclusions are derived.
Dissert. Abstr.

N78-12784 Bowling Green State Univ., Ohio.
ON THE STRUCTURE OF FREE PRODUCTS OF LATTICE ORDERED GROUPS Ph.D. Thesis
James Duncan Franchello 1977 100 p
Avail: Univ. Microfilms Order No. 77-16838

The interrelationships between the lattice and group structures of lattice ordered groups (l-groups) were investigated. The general

techniques are standard algebraic manipulations. Interest centers on L the free product (in the category of l-groups) of disjoint l-groups G and H. The interaction of the free factors of L are studied first by attempting to determine the subgroup of L generated by G and H; second by examining the sublattice of L generated by G and H. Our efforts produce six 'words' in G and H (the group free product of G and H) that must be the identity in L. These are actually six group equations that must hold in L because appropriate lattice conditions hold between certain elements of L. These results by describing two infinite families of these 'words', i.e., arbitrarily long equations as described previously are generalized. Dissert. Abstr.

N78-12785 Purdue Univ., Lafayette, Ind.
SOME RESULTS ON SUBSET SELECTION PROBLEMS Ph.D. Thesis
Yoon-Kwai Leong 1976 130 p
Avail: Univ. Microfilms Order No. 77-15434

A formulation termed the subset selection approach is proposed in which there is a fixed minimum proability over the entire parameter space that the population of interest is selected. Some subset selection procedures for the smallest unknown mean of k Poisson populations are elaborated. An unconditional selection procedure is proposed and a conservative method is given for solving the constant. An upper bound for the expected subset size over a subset of the parameter space is also given. A conditional procedure similar to the previous one but conditioned on the total sum of the observation is proposed and studied. A third and somewhat simpler procedure is also considered and compared with the unconditional rule. Some selection procedures for populations better than a standard are also investigated. A test of homogeneity for the means of Poisson distribution is discussed. Dissert. Abstr.

N78-12786 North Carolina Univ., Chapel Hill.
DISTRIBUTION FUNCTIONS ON PARTIALLY ORDERED SPACES Ph.D. Thesis
Kiang Liu 1976 87 p
Avail: Univ. Microfilms Order No. 77-17341

Extensions of Mobius inversion formulas are considered which express mass function in terms of its distribution function. Under certain conditions, these formulas not only hold for non-negative real valued measures but also hold for abstract measures. History spaces are defined and discussed. Mobius functions for such spaces are computed. All history spaces are proved to have the property that M always determines m. An inversion formula is found to express m in terms of M for a particular history space which arises naturally from boundary crossing problems. Lower finite spaces and finite parameter spaces are discussed. A necessary and sufficient condition, for a space to be a finite parameter space is given. A theory is developed for certain types of finite parameter spaces. Dissert. Abstr.

N78-12787# Massachusetts Inst. of Tech., Cambridge. Center for Information Systems Research.
SET DECOMPOSITION: CLUSTER ANALYSIS AND GRAPH DECOMPOSITION TECHNIQUES
Rafael C. Andrew Sep. 1977 86 p refs
(Contract N00039-77-C-0255)
(AD-A044760; CISR-P010-01-01; CISR-TR-1) Avail: NTIS
HC A05/MF A01 CSCL 12/1

The investigation of a systematic approach for the early phases of the system development process generates the problem of decomposing a given set in which interdependencies have been defined among its elements, so as to obtain a collection of subsets as free of interdependencies as possible. This problem is analyzed and solutions proposed; cluster analysis and graph decomposition techniques are applied and shown to possess some similarities which allow one to approach set decomposition problems within a unified framework. Author (GRA)

N78-12788# Purdue Univ., Lafayette, Ind. Dept. of Statistics.
SUBSET SELECTION PROCEDURES WITH SPECIAL REFERENCE TO THE ANALYSIS OF TWO-WAY LAYOUT: APPLICATION TO MOTOR-VEHICLE FATALITY DATA
Shanti S. Gupta and Jason C. Hsu Sep. 1977 8 p refs
(Contract N00014-75-C-0455)
(AD-A044890; Mimeo-Ser-511) Avail: NTIS
HC A02/MF A01 CSCL 12/1

In this paper, the origin of selection and ranking problems are discussed. Then the two basic approaches to the selection problem - the indifference zone approach and the subset selection approach - are reviewed briefly. As an application, subset selection procedure is applied to motor-vehicle traffic fatality data which fits into a two-way layout. GRA

N78-12789# Purdue Univ., Lafayette, Ind. Dept. of Statistics.
ON SELECTING AN OPTIMAL SUBSET OF REGRESSION VARIABLES
Shanti S. Gupta and D. Y. Huang Jul. 1977 16 p refs
(Contract N00014-75-C-0455)
(AD-A044889; Mimeo-Ser-501) Avail: NTIS
HC A02/MF A01 CSCL 12/1

In the past decade a number of methods have been developed for selecting the best or at least a good subset of variables in regression analysis. For various reasons, there may be interest in including only a subset say, of size r-p, the number of independent variables. Various authors have considered this problem and a variety of techniques are presently being used to construct such subsets. Most of these seem to lack justification in terms of statistical theory. This paper is interested in deriving a selection procedure to select a random size optimal subset such that all inferior independent variables are excluded. Some results on the efficiency of the procedure are also discussed. GRA

N78-12790# Purdue Univ., Lafayette, Ind. Dept. of Statistics.
MINIMAX SUBSET SELECTION FOR LOSS MEASURED BY SUBSET SIZE
Roger L. Berger Aug. 1977 21 p refs
(Contracts N00014-75-C-0455; AF-AFOSR-2350-72)
(AD-A044891; Mimeo-Ser-507) Avail: NTIS
HC A02/MF A01 CSCL 12/2

A subset selection problem is formulated as a multiple decision problem. Then restricting attention to rules which attain a certain minimum probability of correct selection, the minimax value is computed, under general conditions, for loss measured by subset size and number of non-best populations selected. Applying this to location and scale problems, previously proposed rules are found to be minimax. But for problems involving binomial, multinomial and multivariate non-centrality parameters, such as chi square and F, previously proposed rules are found to be not minimax. A class of rules which has been proposed for the location problem is investigated and rules in this class are found to be not minimax in some cases. Author (GRA)

70 PHYSICS (GENERAL)

For geophysics see *46 Geophysics*. For astrophysics see *90 Astrophysics*. For solar physics see *92 Solar physics*.

N78-12791 Wisconsin Univ., Madison.
ELECTROMAGNETIC-GRAVITATIONAL EQUILIBRIUM OF CHARGED BODIES IN GENERAL RELATIVITY Ph.D. Thesis
Ronald Albert Kobiske 1976 145 p
Avail: Univ. Microfilms Order No. 77-15991

Details of the Isreal and Wilson, and Perjex theory of Stationary Electromagnetic-Gravitational Vacuum Fields are reviewed at some length. The second part of the paper deals with the determination of the explicit axially symmetric metric which corresponds to n charged spinning sources which are held in equilibrium under their mutual electromagnetic and gravitational forces. Spin can be parallel or antiparallel along the symmetry axis, spin magnitudes, and magnetic and electric charge parameters are assumed to be arbitrary throughout. Next, the singularity structure of the metric is examined; a condition is obtained for asymptotic flatness of the metric. The relation between electric and magnetic charge and complex mass parameters is discussed, together with the effect of duality rotation of that relation. Finally, it is shown that the above requirement

of asymptotic regularity requires the total magnetic mass of the system to vanish. Dissert. Abstr.

N78-12792 North Carolina Univ., Chapel Hill.
MULTIPOLE MOMENTS IN GENERAL RELATIVITY Ph.D. Thesis
Elaine Yue-Lien Tsiang Place 1976 129 p
Avail: Univ. Microfilms Order No. 77-17480

The class of static and stationary spacetimes, in which the moment integrals converge to all orders, is discussed. The multipole moments of the Kerr and Tomimatsu-Sato metrics are given as examples. The choice of maximal hypersurfaces in a general spacetime is motivated by the conjecture that multipole moments along a foliation of such hypersurfaces give a faithful representation of the distribution of the sources. This is born out in the example of a time-dependent maximal foliation in the Kerr spacetime. Certain general conclusions about the multipole moments of a general spacetime are presented. Dissert. Abstr.

N78-12793# Sandia Labs., Albuquerque, N. Mex.
EQUATIONS OF MOTION FOR A MASS PARTICLE ELASTICALLY MOUNTED ON A DISK SUBJECTED TO TRANSVERSE AND ROTATIONAL ACCELERATIONS
G. A. Benedetti Mar. 1977 26 p
(Contract EY-76-C-04-0789)
(SAND-76-8262) Avail: NTIS HC A03/MF A01

Equations of motion for a mass particle elastically mounted on a disk which is subjected to transverse and rotational accelerations are derived. The idealized problem considered is an approximation to a more complicated problem concerned with the lateral response of a cantilever beam due to the balloting accelerations of a projectile as it accelerates down a rifled gun tube. Some numerical results are presented which illustrate the dynamic behavior of the mass particle when balloting accelerations are presented. ERA

N78-12794# Joint Publications Research Service, Arlington, Va.
TRANSLATIONS ON USSR SCIENCE AND TECHNOLOGY: PHYSICAL SCIENCES AND TECHNOLOGY, NO. 21
31 Oct. 1977 48 p refs Transl. into ENGLISH from Russian journals
(JPRS-70056) Avail: NTIS HC A03/MF A01

The scientific and technological revolutions, and their effects on the training of personnel for computerized design and processing economic data are discussed. Scientific research in the Lithuanian Academy of Sciences is summarized. Biographical sketches of the theoretical physicist Solomon Issakovich Pekar, and the mathematician Marko Grigorvich Kreyn are included. A.R.H.

N78-12795# Joint Publications Research Service, Arlington, Va.
TRANSLATIONS ON EASTERN EUROPE SCIENTIFIC AFFAIRS, NO. 563
1 Nov. 1977 31 p Transl. into ENGLISH from East European journals
(JPRS-70153) Avail: NTIS HC A03/MF A01

Articles are presented from the various theoretical and applied scientific disciplines and technical fields. The administration, structure, personnel, and research plans of leading East European scientific organizations and institutions, particularly the academies of sciences are reviewed. In this issue, documents are published dealing with geological research, computer sciences, chemical polymers, oceanography, and other topics. Author

N78-12796# Joint Publications Research Service, Arlington, Va.
TRANSLATIONS ON USSR SCIENCE AND TECHNOLOGY: PHYSICAL SCIENCES AND TECHNOLOGY NO. 22
7 Nov. 1977 80 p refs Transl. into ENGLISH from Russian journals
(JPRS-70102) Avail: NTIS HC A05/MF A01

Topics covered include: mathematical modeling in the military; computerized design and simulation; aims, methods, achievements, and the use of television in meteor research; standardization and metrology training; and 20 years experience in the Siberian Dept. of the Soviet Academy of Sciences. A.R.H.

71 ACOUSTICS

Includes sound generation, transmission and attenuation.

For noise pollution see *45 Environment Pollution*.

N78-12797 Georgetown Univ., Washington, D.C.
ULTRASONIC NONLINEAR INTERACTION IN ISOTROPIC PLATES Ph.D. Thesis
Neal George Brower 1977 129 p
Avail: Univ. Microfilms Order No. 77-16853

Ultrasonic nonlinear effects in isotropic plates, the three-phonon interaction and second harmonic generation, are investigated. A theoretical background is presented in which solutions to the nonlinear equations of motion are discussed. A new approach for the solution to the nonlinear equations of motion for an isotropic plate is suggested. The approach involves a perturbative approximation to the nonlinear equations of motion and Green's function techniques. The Green's function is constructed via an eigenfunction expansion. Dissert. Abstr.

N78-12798 Purdue Univ., Lafayette, Ind.
PROPAGATION OF FINITE AMPLITUDE HIGHER ORDER MODE SOUNDS IN RIGID AND ABSORBENT DUCTS WITH PARTICULAR APPLICATION TO THE MULTIPLE PURE TONE PROBLEM Ph.D. Thesis
Kuo-Shong Wang 1976 188 p
Avail: Univ. Microfilms Order No. 77-15489

Multiple pure tone noise is generated by the nonlinear wave interactions in the inlet of turbofan engines when the relative tip speed of the fan blades is supersonic. In conjunction with this problem, the propagation of finite amplitude sound waves in a rigid walled or soft walled duct was analyzed both theoretically and experimentally. The resonance expansion method was employed to determine the nonlinear interactions, so called the internal resonance. Numerical examples for several situations are given. A nondimensional parameter obtained by combining the amplitude, frequency, and duct dimension plays the significant role in the generation of other harmonics. Experiments were performed for higher order mode, finite amplitude sound waves with rigid and soft wall conditions. Theories and experiments are compared. Dissert. Abstr.

N78-12799*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
MEASUREMENTS AND ANALYSIS OF FAR-FIELD SCATTERING FROM A PROLATE SPHEROID
A. Bayliss and L. Maestrello Oct. 1977 22 p refs
(NASA-TM-74098) Avail: NTIS HC A02/MF A01 CSCL 20A

The far-field acoustic scattering by a prolate spheroid with axial point sources near the tip of the body was measured. Data were taken for ka between 10 - 160 where (a) is the semi-major axis of the spheroidal. Comparisons were made with numerical results obtained by an integral equation based on the simple source method, with appropriate coordinate stretching introduced to permit high frequency solutions with a minimal number of grid points. Theory and experiment agree within experimental error except for the highest frequencies in the shadow region, where very rapid changes in pressure make precise measurements difficult. The results show that for frequencies of aeroacoustic interest, the scattered field is very large and cannot be ignored. Author

N78-12800*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
MEASUREMENTS OF THE TONAL COMPONENT OF CAVITY NOISE AND COMPARISON WITH THEORY
P. J. W. Block Nov. 1977 34 p refs
(NASA-TP-1013; L-11620) Avail: NTIS HC A03/MF A01 CSCL 20A

The frequency of the tonal noise generated by a flow-excited rectangular cavity was measured using Mach numbers ranging from 0.05 to 0.40, and cavity length-to-depth ratios varying from 0.1 to 8. The data are used to evaluate a current prediction method, and good agreement is shown. Measurements of the minimum streamwise cavity length required for oscillation were also made. Author

N78-12801*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
AN EXPERIMENTAL EVALUATION OF THE APPLICATION OF THE KIRCHHOFF FORMULATION FOR SOUND RADIATION FROM AN OSCILLATING AIRFOIL
Thomas F. Brooks Washington Dec. 1977 39 p refs
(NASA-TP-1048; L-11479) Avail: NTIS HC A03/MF A01 CSCL 20A

The Kirchhoff integral formulation is evaluated for its effectiveness in quantitatively predicting the sound radiated from an oscillating airfoil whose chord length is comparable with the acoustic wavelength. A rigid airfoil section was oscillated at small amplitude in a medium at rest to produce the sound field. Simultaneous amplitude and phase measurements were made of surface pressure and surface velocity distributions and the acoustic free field. Measured surface pressure and motion are used in applying the theory, and airfoil thickness and contour are taken into account. The result was that the theory overpredicted the sound pressure level by 2 to 5, depending on direction. Differences are also noted in the sound field phase behavior.
Author

N78-12802# Michigan Univ., Ann Arbor. Cooley Electronics Lab.
BASIC RESEARCH IN UNDERWATER ACOUSTIC PROPAGATION STABILITIES AND RELATED SIGNAL PROCESSING Final Report, 1 Jan. 1975 - 28 Feb. 1977
T. G. Birdsall Aug. 1977 19 p refs
(Contract N00014-75-C-0174)
(AD-A043958; FR-013514-F) Avail: NTIS HC A02/MF A01 CSCTL 17/1

This report summarizes the theoretical and laboratory work performed under contract N00014-75-C-0174 with the U.S. Navy, Office of Naval Research, during the period 1 January 1975 to 28 February 1977.
Author (GRA)

N78-12803# Denver Research Inst., Colo. Div. of Mathematical Sciences.
A DIRECT MIGRATION PROCEDURE FOR ACOUSTIC WAVES
Jack K. Cohen and Norman Bleistein 22 Aug. 1977 26 p refs
(Contracts N00014-76-C-0039; N00014-76-C-0079)
(AD-A044284; MS-R-7803) Avail: NTIS HC A03/MF A01 CSCL 20/1

Direct migration provides a means of developing a subsurface profile by direct processing (i.e., weighted quadratures) of the field data. A direct migration formula is presented for a medium that supports acoustic waves. A number of examples are presented which demonstrate the direct migration procedure. Included are tilted interfaces with dip angle up to 45 deg (the dip angle is accurately reproduced in all cases), a syncline, an anticline and a lens shaped inclusion in a two layered medium. Velocities and locations of interfaces are produced with errors of less than 4%.
Author (GRA)

N78-12804# Rockwell International Corp., Thousand Oaks, Calif. Science Center.
ANALYSIS OF ULTRASONIC WAVE SCATTERING FOR THE CHARACTERIZATION OF DEFECTS IN SOLIDS Final Report, 1 Feb. 1974 - 15 Mar. 1977
E. Richard Cohen May 1977 59 p refs
(Contract F44620-74-C-0057)
(AD-A044720; SC579.4FR; AFOSR-77-1206TR) Avail: NTIS HC A04/MF A01 CSCL 11/6

Measurements and analysis have been carried out on the scattering of ultrasonic elastic waves by voids and solid inclusions in titanium alloy. Both direct scattered amplitudes and mode converted scattering amplitudes were measured for incident shear and incident compressional plane waves. The scatterers were spherical and ellipsoidal in shape. Exact calculation for spherical shapes of arbitrary radius and elastic properties were obtained and compared with the experimental measurements. For other shapes, exact calculations are either impossible or impractical. Scattering from an arbitrary shape was expressed in terms of an integral equation from which an improved Born approximation reduces to the Rayleigh limit for scattering by spheres at low frequencies and to the known static stress field in ellipsoids for zero frequencies. The use of a variational approach has been explored which appears to have the capability of significantly extending the range of validity of the usual long wavelength limit approximations.
Author (GRA)

N78-12805# Navy Underwater Sound Lab., New London, Conn.
SPECTRUM OF A SIGNAL REFLECTED FROM A TIME-VARYING STOCHASTIC SURFACE
Benjamin F. Cron and Albert H. Nuttall 15 Dec. 1969 11 p Presented at 78th meeting of Acoust. Soc. Am., San Diego, Calif., 3-7 Nov. 1969
(ZR0110101)
(AD-A044687; NUSL-TM-2211-331-69) Avail: NTIS HC A02/MF A01 CSCL 20/1

The purpose of this study is to determine the frequency spread caused by reflection of an acoustic signal off a time-varying stochastic surface.
GRA

N78-12806# Naval Ocean Systems Center, San Diego, Calif.
PARABOLIC EQUATION PREDICTIONS COMPARED WITH ACOUSTIC PROPAGATION MEASUREMENTS FROM PROJECT FASMAN TWO Final Report, Oct. - Dec. 1975
K. M. Guthrie (Defence Sci. Estab., Aukland, New Zealand) and D. F. Gordon 1 Aug. 1977 41 p refs
(SF52552602)
(AD-A045120; NOSC/TR-133) Avail: NTIS HC A03/MF A01 CSCL 20/1

The parabolic equation method for computing acoustic propagation losses was used to model the results of the Tasman Two Sea Tests. In these tests aircraft dropped SUS (signals, underwater sound) charges along four great circular paths from a hydrophone near South Island, New Zealand, in westerly directions across the South Tasman Sea and Southeast Indian Ocean. The data were processed in 1/3 octave bands from 16 to 1000 Hz. The best available sound speed, bathymetric, and sediment data were compiled both from Tasman Two Sea Tests data and from historical data. These data were used to make parabolic equation runs along the radials starting at the stationary receiver for 63 and 125 Hz. Great care was required in progressing down the continental slope from the receiver and over sea mounts where small step sizes in the numerical solution were required. Accurate modeling of sediments was also required in these areas. In the immediate vicinity of the hydrophone a ray theory for a wedge gave better starting values for the parabolic method than did a normal mode technique. Agreement between computations and experiment was generally good enough to substantiate the techniques used. Poor agreement for the most southerly radial suggested inadequate knowledge of the bathymetry and sediments within 200 km of the hydrophone. Shadowing behind seamounts was found to be strongly dependent on the nature of the sediment cover.
Author (GRA)

N78-12807# Texas Univ., Austin. Applied Research Labs.
AN EXTENSION OF LANGER'S ASYMPTOTIC SOLUTION WITH APPLICATIONS TO OCEAN ACOUSTICS Ph.D. Thesis
Stephen K. Mitchell 1 Mar. 1977 159 p refs
(Contract N00014-75-C-0429)
(AD-A045346; ARL-TR-77-13) Avail: NTIS HC A08/MF A01 CSCL 20/1

In this dissertation, Langer's asymptotic solution for second order differential equations is applied to the problem of acoustical propagation in the ocean. Langer's solution is analogous to the WKB solution, but is developed in terms of the Airy functions. For illustrative c(z) functions (sound velocity vs. depth) typical of the deep ocean, the normal mode quantities of group velocity and mode cycle distance are computed using the formulae developed in this report. These are presented in the form of plots of, for example, group velocity versus phase velocity for frequencies in the range 10 Hz to 150 Hz. These plots illustrate the effects of the ocean surface and of anomalous segments of c(z) upon the mode quantities; the most prominent frequency dependent effects occur for modes whose phase velocities are close to the sound velocity at a boundary.
GRA

N78-12808# Utah Univ., Salt Lake City. Dept. of Chemistry.
PIEZOELECTRIC DETECTION OF PHOTOACOUSTIC SIGNALS Interim Technical Report

Michael M. Farrow, Roger K. Burnham, Max Auzanneau, Steven L. Olsen, and Neil Purdie 19 Sep. 1977 22 p refs
(Contract N00014-75-C-0796)
(AD-A045217; TR-14) Avail: NTIS HC A02/MF A01 CSCL 20/1

Piezoelectric detection of photoacoustic signals offers a number of advantages over the better known microphonic technique for condensed phase samples. Experimental techniques are greatly simplified by taking advantage of the acoustic impedence match offered by solid state detectors with solid or liquid samples. Such piezoelectric detectors prove suitable for a.c. steady state measurements as well as impulse-transient response detectors. Several example spectra of Nd(III) are presented with emphasis on the effects of the fluorescence lifetime in Nd:glass laser material. Author (GRA)

72 ATOMIC AND MOLECULAR PHYSICS

Includes atomic structure and molecular spectra.

N78-12809 California Univ., Berkeley.
REACTIVE SCATTERING OF HALOGEN MOLECULES Ph.D. Thesis
James Joseph Valentini 1976 175 p
Avail: Univ. Microfilms Order No. 77-15897

We describe a study of the endoergic, bimolecular reactions of F2 with I2, IC1, and HI in a crossed molecular beam experiment. The trihalogens IIF, CII, and HIF have been directly observed as the products of these reactions. Analysis of product center-of-mass angular distributions indicates that a slightly non-linear approach is most effective in bringing about reaction to form the stable triatomic radical. Also described is a crossed molecular beam study of the Cl + Br2 producing BrCl + Br reaction. The results indicate that this reaction has the characteristics of an exoergic reaction on an attractive potential energy surface with early energy release. Finally, we describe a series of computer programs which can be used to carry out the requisite data analysis for crossed molecular beam reactive scattering experiments.
Dissert. Abstr.

N78-12810 Rochester Univ., N. Y.
THE HEISENBERG EQUATION OF MOTION APPLIED TO THE FREE ELECTRON, AND TO THE TWO-LEVEL ATOM DRIVEN BY A FINITE-BANDWIDTH LASER FIELD Ph.D. Thesis
Shu Biu Lai 1977 180 p
Avail: Univ. Microfilms Order No. 77-16233

The Heisenberg picture approach was considered and applied to several problems including: (1) the classical Lorentz theory of the free electron which admits some unphysical solutions known as runaway solutions; (2) the free electron's g-2 anomaly being positive in sign; and (3) optical intense-field two-level resonance fluorescence. Dissert. Abstr.

N78-12811 Purdue Univ., Lafayette, Ind.
A STUDY OF THE SPECTRUM AND STRUCTURE OF THE NEUTRAL VANADIUM ATOM Ph.D. Thesis
David Scott Davis 1976 634 p
Avail: Univ. Microfilms Order No. 77-15399

Theoretical and experimental investigations of the spectrum and structure of the neutral vanadium atom were performed by the following methods: (1) a remeasurement of the photographic V I emission spectrum by means of more sophisticated instrumentation, (2) an effort to calculate from theoretical principles the properties of the eigenstates of the neutral vanadium atom, (3) a search, by means of near infrared Fourier spectroscopic techniques, for new even parity states of intermediate energy, and (4) an investigation of the ultraviolet vanadium absorption spectrum in order to search for new high lying odd parity states. Approximately 1600 atomic emission lines have been measured, by means of an automatic comparator facility developed for this purpose, in the wavelength region 2500 - 8500 A. In addition, about 950 absorption lines in the range 1900 - 3400 A and 450 near infrared emission lines between 1.0 and 4.0 um have been observed. Approximately 530 energy levels for the neutral vanadium atom are now established with a high degree of structural consistency. These include several new even parity terms of intermediate energy which apparently arise from the five equivalent 3d electron configuration and four high sextet odd parity multiplets arising from configurations involving a 5p electron. Dissert. Abstr.

N78-12812 North Carolina Univ., Chapel Hill.
A HIGH RESOLUTION STUDY OF L X-RAYS PRODUCED BY FAST HEAVY IONS Ph.D. Thesis
Barney Lee Doyle 1976 134 p
Avail: Univ. Microfilms Order No. 77-17314

Thick zirconium and silver targets were bombarded by 1-5 MeV/amu H(), He(+2), Li(+3), C(+5), and O(+n) ions. The subsequent L X-rays were energy analyzed by high resolution crystal spectroscopy. The impact parameter ionization probabilities were also determined by extension of the harmonic oscillator semiclassical approximation and the binary encounter approximation. The cutoff atomic numbers were determined for the L sub 1-L sub 3 M sub 4, 5 and L sub 1 L sub 3 M sub 4, 5 Coster-Kronig transitions using a curved crystal spectrometer. The operating principles and related electronics of both X-ray spectrometer systems are discussed. The focusing properties of curved and ground crystals is also reviewed. Dissert. Abstr.

N78-12813 Kansas State Univ., Manhattan.
X-RAY PRODUCTION CROSS SECTIONS FOR BARE AND ONE-ELECTRON FLUORINE, OXYGEN, NITROGEN, CARBON, AND BORON PROJECTILES FOLLOWING ELECTRON CAPTURE IN HELIUM TARGETS IN THE ENERGY RANGE FROM 0.25 TO 2.3 MeV/amu Ph.D. Thesis
James Andrew Guffey 1976 85 p
Avail: Univ. Microfilms Order No. 77-16010

Experimental data is presented for K-shell radiation from bare and one-electron incident ions of F, O, N, C, and B following collisions with He gas targets in the energy range from 0.25 - 2.3 MeV/amu. For bare nuclei the radiation results from the decay of excited states formed by electron capture processes, and for one-electron incident ions this process dominates at low velocity while excitation predominates when the projectile velocity exceeds the mean velocity of the K-shell electron. For light ion-atom systems the capture is predominately to the ground state of the ion, however, for heavier projectiles the contribution to the excited states increases. If only loosely bound electrons are available for capture, the capture to excited states accounts for the majority of the capture. The experimental X-ray production cross sections were compared to predictions based on a closed form one-election capture calculation in the Brinkman-Kramers approximation. Dissert. Abstr.

N78-12814 Auburn Univ., Ala.
MATHEMATICAL MODELLING OF ELECTRICAL CONDITIONS, PARTICLE CHARGING, AND THE ELECTROSTATIC PRECIPITATION PROCESS Ph.D. Thesis
Jack Raymond McDonald 1977 199 p
Avail: Univ. Microfilms Order No. 77-16836

Models describing the electrical conditions and particle charging were incorporated with an existing model for charged particle transport to the collection surface to obtain a complete model for determining electrical conditions in wire-plate electrostatic precipitators. Voltage-current characteristics are obtained and the electric potential and electric field intensity as functions of position for each applied voltage and current are determined. A particle charging theory, based on concepts from kinetic theory are presented and applied to, and determine the charging rate in terms of the probability of collisions between the dust particles and ions. Dissert. Abstr.

N78-12815 Rochester Univ., N. Y.
RESONANCE FLUORESCENCE IN MANY-LEVEL ATOMS Ph.D. Thesis
Blaise Renaud 1976 193 p
Avail: Univ. Microfilms Order No. 77-16247

The general Heisenberg picture formalism of the transition-projection atomic operators is used to describe resonance fluorescence from an atomic system interacting with a constant amplitude monochromatic radiation field. The time evolution of

atomic operator expectation values and of first order correlation functions is fully investigated. The spectrum of the light transmitted by a Fabry-Perot interferometer and measured by a detector varies depending on from which portion of the interaction region of observation of the scattered light is made. Several interesting features in the lineshape of such a spectrum related to the sudden turn-on of the interaction, and others to the finite observation interval are discussed. This general formalism is then applied to two particular atomic systems: to a two-level atom whose population escapes to other levels during the process of the interaction and to a four-level system. Dissert. Abstr.

N78-12816# Washington Univ., Seattle. Dept. of Chemistry.
VIBRATIONAL-TRANSLATIONAL ENERGY TRANSFER IN ATOM-POLYATOMIC MOLECULE COLLISIONS IN THERMAL REACTION SYSTEMS
I. Oref and B. S. Rabinovitch 15 Aug. 1977 17 p refs
(Contract N00014-75-C-0690)
(AD-A044435; NR092-549-TR05) Avail: NTIS HC A02/MF A01 CSCL 20/8

Vibrational-translational energy transfer probabilities and collisional efficiencies are calculated for atom-polyatomic molecule collisions. It is assumed that a collision complex is formed and that the total internal vibrational energy is statistically distributed among all the modes of the complex. An attractive potential is assumed and account is taken of the centrifugal barrier. Conservation of system angular momentum is imposed. Convolution of the several thermal distribution functions is carried out and completeness and detailed balance are observed. Comparison of calculated quantum statistical quantities with experiment is made for the thermal isomerization of methyl and ethyl isocyanide in the presence of heavy atomic bath gases, such as Xe or Ar, and semiquantitative agreement is found. Author (GRA)

N78-12817# Indiana Univ., Bloomington. Dept. of Chemistry.
REPORT ON COMBINED MEETING OF THE COLLOQUIUM SPECTROSCOPICUM INTERNATIONALE, 20TH AND INTERNATIONAL CONFERENCE ON ATOMIC SPECTROSCOPY, 7TH
Gary M. Hieftje Sep. 1977 15 p Conf. held at Czechoslovakia
(Contract N00014-76-C-0838)
(AD-A044738; TR-7) Avail: NTIS HC A02/MF A01 CSCL 07/4

Highlights of a recent international conference are presented. The conference, which combined the XX Colloquium Spectroscopicum Internationale and the 7th International Conference on Atomic Spectroscopy, was held in Czechoslovakia from August 30 to Sept. 8, 1977. Although the meeting covered a number of facets of analytical chemistry and spectroscopy, this report emphasizes those parts dealing with atomic spectroscopy. In the report, trends in this field are identified and important new findings related. Author (GRA)

N78-12818# United Technologies Research Center, East Hartford, Conn.
ROTATIONAL POPULATION TRANSFER IN HF Final Report, 1 May 1976 - 31 Aug. 1977
J. J. Hinchen and R. H. Hobbs 30 Aug. 1977 57 p refs
(Contract F44620-76-C-0112)
(AD-A044567; UTRC/R77-952595-1; AFOSR-77-1202TR)
Avail: NTIS HC A04/MF A01 CSCL 20/8

Population transfer in HF was measured by an IR double resonance experiment which uses HF pump and probe lasers. In three kinds of experiments populations pumped to a specific rotational level were followed: out of the pumped level, to the levels above, and to the levels below. The rates of loss from the pumped level and transfer to the lower levels were strongly affected by lasing between rotational levels. Measurements were made of gain and laser intensity and that information was incorporated into a kinetic rate model to assess contributions to the total transfer rates. The collisional contributions are compared with linewidth data. Information was also obtained on population transfer rates for velocity cross relaxation and for vibration-rotation transfer. Author (GRA)

N78-12819# Harry Diamond Labs., Adelphi, Md.
A MACHINE-LANGUAGE COMPUTER PROGRAM TO OBTAIN A NEUTRON SPECTRUM FROM A PHOTON-RECOIL SPECTRUM
Craig R. Heimbach Sep. 1977 31 p refs
(AD-A045002; HDL-TM-77-18) Avail: NTIS HC A03/MF A01 CSCL 20/8

An assembly-language computer program has been written for an ND812 minicomputer. The program allows rapid analysis of proton-recoil data by calculation of the neutron flux directly on the minicomputer. An oscilloscope displays the results. The data may then be examined without their being transferred to an external computer. Author (GRA)

N78-12820# Battelle Pacific Northwest Labs., Richland, Wash.
RADIOLOGICAL PHYSICS AND DOSIMETRY RESEARCH WITH A SMALL POSITIVE ION ACCELERATOR
W. E. Wilson Oct. 1976 20 p refs Presented at 4th Ann. Conf. on the Use of Small Accelerators, Denton, Tex., 25-27 Oct. 1976
(Contract E(45-1)-1830)
(BNWL-SA-5966; Conf-761059-18) Avail: NTIS HC A02/MF A01

The distribution of energy along and around the path of charged particles is the fundamental determinant of the chemical and biological effects of ionizing radiation. The current status for measuring the energy deposition in simulated biological matter is reviewed. Inasmuch as current radiobiological information indicates that the sensitive volume is very small, diameter of order one micrometer or smaller, deposition in volumes of this dimension are of primary interest. Limitations of experimental techniques make the direct measurement of energy deposition in such small volumes difficult and hence very uncertain. A Monte Carlo method for calculating this discreet initial track structure is discussed. The input data for calculations of microscopic energy depositions are double differential cross sections for electron ejection by energetic ions. The current status of the experimental measurement of these cross sections is reviewed. ERA

73 NUCLEAR AND HIGH-ENERGY PHYSICS

Includes elementary and nuclear particles; and reactor theory.

For space radiation see *93 Space Radiation*.

N78-12821 California Univ., Berkeley.
CARBON AND DEUTERIUM NUCLEAR MAGNETIC RESONANCE IN SOLIDS Ph.D. Thesis
Thomas Wayne Shattuck 1976 353 p
Avail: Univ. Microfilms Order No. 77-15855

Cross polarization dynamics between protons and carbon-13 in adamantane by the direct observation of the dilute, carbon-13 spins. The experimental and theoretical proton dipolar fluctuation correlation times were compared to provide the background for extensions to deuterium and double quantum effects. An approach to high resolution nmr of deuterium in solids is described. The m = 1 yields minus 1 transition is excited by a double quantum process and the decay of coherence is monitored. Fourier transformation gives a deuterium spectrum devoid of quadrupole splittings and broadening. The extension of cross relaxation techniques, both direct and indirect, to proton-deuterium double resonance is also described. Dissert. Abstr.

N78-12822 California Univ., Berkeley.
THE STUDY OF MUONIC STATES IN SEMICONDUCTORS Ph.D. Thesis
Richard Franklin Johnson 1976 111 p
Avail: Univ. Microfilms Order No. 77-15722

A beam of polarized positive muons was stopped in semi-conducting materials situated in a uniform magnetic field transverse to the beam direction. The precession of the positive muon was observed by detection of the decay positron coming from the asymmetric decay of the muon. Long-lived muonium was observed via its two-frequency precession in p-type samples of silicon and germanium. From the precession frequencies of

muonium in silicon and germanium it has been determined that the Fermi contact interaction is reduced in these media compared to its vacuum value. The positive muon and muonium precession frequencies was detected in p-type silicon. The field dependence of these precession frequencies has been studied for two different crystal orientations in the external field. A shift in these anomalous frequencies has been detected for the two crystal orientations at all fields. Dissert. Abstr.

N78-12823*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
AN ANALYSIS OF THE BACK END OF THE NUCLEAR FUEL CYCLE WITH EMPHASIS ON HIGH-LEVEL WASTE MANAGEMENT, VOLUME 1
12 Aug. 1977 55 p refs 2 Vol.
(Contract NAS7-100)
(NASA-CR-155319; JPL-Pub-77-59-Vol-1) Avail: NTIS HC A04/MF A01 CSCL 18G

The programs and plans of the U.S. government for the 'back end of the nuclear fuel cycle' were examined to determine if there were any significant technological or regulatory gaps and inconsistencies. Particular emphasis was placed on analysis of high-level nuclear waste management plans, since the permanent disposal of radioactive waste has emerged as a major factor in the public acceptance of nuclear power. The implications of various light water reactor fuel cycle options were examined including throwaway, stowaway, uranium recycle, and plutonium plus uranium recycle. The results of this study indicate that the U.S. program for high-level waste management has significant gaps and inconsistencies. Areas of greatest concern include: the adequacy of the scientific data base for geological disposal; programs for the the disposal of spent fuel rods; interagency coordination; and uncertainties in NRC regulatory requirements for disposal of both commercial and military high-level waste.
Author

N78-12824*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
AN ANALYSIS OF THE BACK END OF THE NUCLEAR FUEL CYCLE WITH EMPHASIS ON HIGH-LEVEL WASTE MANAGEMENT, VOLUME 2
12 Aug. 1977 195 p refs 2 Vol.
(Contract NAS7-100)
(NASA-CR-155320; JPL-Pub-77-59-Vol-2) Avail: NTIS HC A09/MF A01 CSCL 18G
For abstract, see N78-12823.

N78-12825# Brookhaven National Lab., Upton, N. Y.
SMALL MOMENTUM WIDTH BEAMS IN ISABELLE: A USEFUL FEATURE FOR EXPERIMENTS
J. W. Humphrey 7 Feb. 1977 3 p
(Contract EY-76-C-02-0016)
(BNL-50638) Avail: NTIS HC A02/MF A01

The energy width of beams in proton storage rings is an adiabatic invariant and, therefore, only a weak function of energy. For low current stacks, small momentum width beams are, therefore, possible. It is found that under conditions of reduced luminosities, the rms full width of the momentum distribution of the beams in ISABELLE is in the region of 5 to 20 MeV. It is interesting that for electrons, the energy width of the beams is determined by the balance of radiation damping and quantum fluctuations and is, in fact, a strong function of energy. A comparison with e + e- colliding beams is made, showing that fine energy resolution is unique to proton machines in the high-energy regime. The limitations on the energy width attainable due to the interaction of the beam with high frequency beam induced longitudinal fields are also considered. ERA

N78-12826# Texas A&M Univ., College Station. Dept. of Physics.
PARAMETERIZATION OF SHORT-RANGE TIME-IRREVERSIBILITY IN NUCLEAR FORCES
Judith Binstock, R. Bryan, and A. Gersten 1976 88 p refs
(Contract FY-76-S-05-5223)
(ORO-5223-03) Avail: NTIS HC A05/MF A01

In a time-irreversible one-bosom-exchange nucleon-nucleon potential model Bryan and Gersten, T-violation occurs mostly in the lowest-permitted angular momentum states. This leads to the construction of a phase-shift parameterization of the 50 to 450 Mev NN data where T-violation takes place only in the lowest possible angular momentum states. Unique predictions for the relative angular distributions of time-reversalasymmetric observables P - A and P/sub A/ - P/sub B/, even though the absolute magnitudes remain undetermined. The model corresponds to an ordinary interaction that yields the usual experimental data, plus a superimposed very short-range T-noninvariant force. As such, it directs experimentalists to those angular regions of pp and np P - A and P/sub A/ -P/sub B/measurements where T-violation due to short-range forces will be most strongly manifest. As the model incorporates isospin invariance, the predictions are likely to have the greatest significance in the case of pp scattering. ERA

74 OPTICS

Includes light phenomena.

N78-12827 Carnegie-Mellon Univ., Pittsburgh, Pa.
SPACE VARIANT OPTICAL CORRELATION USING COORDINATE TRANSFORMATIONS Ph.D. Thesis
Demetri Psaltis 1977 141 p
Avail: Univ. Microfilms Order No. 77-16777

An approach to space variant coherent optical data processing which increases the flexibility and practicality of optical processors that have been largely restricted in the past only to Fourier transform related operations is described. Distortion invariance is achieved by the use of coordinate transformations applied to the input data and a procedure for determining the required coordinate transformation for a particular distortion, is also presented. Input distortions introduced by scale and rotational changes in the input data are discussed. To achieve multiple invariance, that is invariance to many distortions simultaneously, a method of extracting the phase information from a holograph - ic recording is developed. Dissert. Abstr.

N78-12828 California Univ., Los Angeles.
THE APPLICATION OF THE FINITE ELEMENT TECHNIQUE TO ARBITRARILY SHAPED DIELECTRIC OPTICAL WAVEGUIDES Ph.D. Thesis
Kee Whan Ha 1977 172 p
Avail: Univ. Microfilms Order No. 77-16169

The finite element technique was applied to the solution of electromagnetic wave propagation in arbitrarily shaped inhomogeneous fiber optics and integrated optics. The technique is based on the variational expression of the wave propagation equations. Elementary waveguide matrices for each finite element were formulated from the variational expression, based on a linear field approximation within the element. A generalized algebraic eigenvalue problem was constructed by summing up the contributions from all finite elements. The solution of this eigenvalue problem was obtained by a direct-iterative eigensolution technique, using a reduced set of generalized coordinates. After confirming the validity of the finite element method, solutions for a variety of optical waveguide structures were obtained, including: triangular, elliptical, rectangular, single material guide, diffused, channel, embossed, and stripline cross-sections.
Dissert. Abstr.

N78-12829*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
ANALYSIS AND DESIGN OF A REFRACTIVE VIRTUAL IMAGE SYSTEM
William M. Kahlbaum Washington Nov. 1977 76 p refs
(NASA-TP-1066; L-11678) Avail: NTIS HC A05/MF A01 CSCL 20F

The optical performance of a virtual image display system is evaluated. Observation of a two-element (unachromatized doublet) refractive system led to the conclusion that the major source of image degradation was lateral chromatic aberration. This conclusion was verified by computer analysis of the system. The lateral chromatic aberration is given in terms of the resolution of the phosphor dots on a standard shadow mask color cathode ray tube. Single wavelength considerations include: astigmatism, apparent image distance from the observer, binocular disparities and differences of angular magnifcation of the images presented to each of the observer's eyes. Where practical, these results

are related to the performance of the human eye. All these techniques are applied to the previously mentioned doublet and a triplet refractive system. The triplet provides a 50-percent reduction in lateral chromatic aberration which was the design goal. Distortion was also reduced to a minimum over the field of view. The methods used in the design of the triplet are presented along with a method of relating classical aberration curves to image distance and binocular disparity. Author

N78-12830# Rockwell International Corp., Anaheim, Calif. Electronics Operations.
OPTICAL WAVEGUIDE LENSES, 2 Final Technical Report, 1 Dec. 1975 - 1 Dec. 1976
D. B. Anderson, R. L. Davis, J. T. Boyd, R. R. August, W. H. Southwell, C. L. Chen, and V. G. Kreismanis Wright-Patterson AFB, Ohio AFAL Jun. 1977 272 p refs
(Contract F33615-76-C-1040)
(AD-A044207; C76-1187.13/501; AFAL-TR-77-60) Avail: NTIS HC A02/MF A01 CSCL 20/6

The results of an effort to further improve thin-film waveguide lens elements for implementation of the optical Fourier transform as may be employed for real-time RF spectral analysis is delineated. Thin-film waveguide positive inhomogeneous refractors identified as generalized Luneberg lenses were investigated calculating the performance and demonstrating their operation with quantitative measurement of the diffraction patterns. They were assembled as inverting beam expanders and lenses were used with retroreflectors for folding. The effort included the demonstration of waveguide coupled photodetector arrays for application in the spatial frequency plane of the transform lens. Charge coupled readout mechanization of the detectors was demonstrated. A numerical procedure was developed to compute the performance of thin-film waveguide generalized Luneberg lenses and lens systems. Using the waveguide lens thickness profile, ray traces through the inhomogeneous lens can be determined together with the ray intercept in the image plane to provide wavefront phase error to determine the resulting intensity diffraction pattern. The procedure allows the introduction of various waveguide thickness profile errors. GRA

N78-12831# Syracuse Univ., N. Y. Dept. of Electrical and Computer Engineering.
TWO-DIMENSIONAL DIRECT ELECTRONIC FOURIER TRANSFORM (DEFT) DEVICES: ANALYSIS, FABRICATION, AND EVALUATION Interim Report, 10 Jun. 1976 - 9 Jun. 1977
Stephen T. Kowel, Philipp G. Kornreich, K. W. Loh, Amaresh Mahapatra, and Moosa Mehter 30 Jun. 1977 102 p refs
(Contract DAAG53-76-C-0162; DA Proj. 1S7-62709-DH-95)
(AD-A044021; TR-77-5) Avail: NTIS HC A06/MF A01 CSCL 09/5

This document serves as the interim report for the period 10 June 1976 to 9 June 1977 on the project entitled, Direct Electronic Fourier Transforms of Images, funded by the U.S. Army Night Vision Laboratory. It was demonstrated that films possess a large surface acoustic wave (SAW)-related conductivity modulation proportional to the square of the SAW-associated electric field in the LiNb03 substrate, as expected. Thus the modulation provided the pseudo-beam steering effect on which the two-dimensional Fourier transformation property rests. GRA

N78-12832# Eikonix Corp., Burlington, Mass.
DESIGN AND FEASIBILITY STUDY OF HOC AS A VAN MOUNTED STEREO MODEL DIGITIZER Final Report
12 Jul. 1977 66 p refs
(Contract DAAK70-77-C 0027)
(AD-A044280; EC/2106601-FR; ETL-0109) Avail: NTIS HC A04/MF A01 CSCL 20/6

This report documents the results of the evaluation of the feasibility and applicability of a potential HOC (heterodyne optical correlation) system as a van mounted stereomodel digitizer. A HOC system model has been developed and it is evaluated by considering the tolerance specifications of the optical, mechanical and electronic subsystems as a function of their required performance characteristics. The results of this study indicate that a potential HOC system is highly competitive in its application as a van mounted stereomodel digitizer. Finally a conceptual design for a prototype HOC system has been presented and its potential advantages over other automated compilation systems were outlined. Author (GRA)

N78-12833# Xonics, Inc., Santa Monica, Calif.
TABULATION OF IMPURITY ABSORPTION SPECTRA: ULTRAVIOLET AND VISIBLE, VOLUME 1 Technical Report, 1 Jan. - 30 Jun. 1977
H. Vora, M. Flannery, and M. Sparks 30 Jun. 1977 259 p refs
(Contracts DAHC15-73-C-0127; DAHC15-72-C-0129; DARPA Order 1969)
(AD-A044509; TR-9) Avail: NTIS HC A12/MF A01 CSCL 20/6

The optical-absorption spectra of commonly occurring impurities in several ultraviolet-transparent solids are tabulated and discussed, and the assignments of the absorption bands are reviewed. The wavelength region included extends from the very near infrared, at 1 micrometer (0.124 eV), through the vacuum-ultraviolet region. The host materials covered are LiF, NaF, KCl, MgF2, CaF2, MgO, Al2O3, SiO2, and silicate glasses. The results are presented in a way useful in locating impurities that absorb at specified wavelengths, in determining the wavelength region in which a specific impurity absorbs, and for general use in several current and envisioned programs. GRA

N78-12834# General Research Corp., McLean, Va.
TACTICAL ELECTROOPTICAL EFFECTIVENESS MODEL, PHASE 2, VOLUME 1 Final Report, Jun 1975 - Jun. 1977
Ralph Zirkind and Richard E. Forrester Jun. 1977 91 p
(Contract DAAK02-74-C-0366)
(AD-A044596; CR-191) Avail: NTIS HC A05/MF A01 CSCL 17/8

The report covers the recently completed effort in an on-going program of land-combat search and its simulation. It involves the incorporation of a tactical electrooptical effectiveness model into the combat simulation model, CARMONETTE. Volume I identifies the modifications in CARMONETTE rule structure that were necessary for this incorporation. Three cases of small unit action were simulated with the resulting model employing both thermal and image intensifier devices in nighttime scenarios. Volume II reports their results. Author (GRA)

N78-12835# Illinois Univ., Urbana-Champaign. Dept. of Computer Science.
OPTOBUNDLE: A UNIQUE FIBER OPTIC MULTIPLIER
Daniel A. Pitt, Wolfgang J. Poppelbaum, and Christ J. Xydes Jun. 1977 32 p refs
(Contract N00014-75-C-0982)
(AD-A044599; UIUCDCS-R-77-882) Avail: NTIS HC A03/MF A01 CSCL 09/2

This paper describes the design and construction of a failsoft single digit decimal multiplier that exhibits almost total immunity to electromagnetic interference. Bundles of glass fiber light guides not only carry the numerical information but actually perform the multiplication as well. Nearly trivial hardware requirements make the device both reliable and inexpensive. Author (GRA)

75 PLASMA PHYSICS

Includes magnetohydrodynamics and plasma fusion.

For ionospheric plasmas see *46 Geophysics*. For space plasmas see *90 Astrophysics*.

N78-12836 Texas Technological Univ., Lubbock.
FAST WAVE RESONANCES NEAR THE ION CYCLOTRON FREQUENCY Ph.D. Thesis
Richard E. Dollinger 1976 77 p
Avail: Univ. Microfilms Order No. 77-16027

Wave damping was observed for the fast (compressional) wave at frequencies that are about 10% above the second and the third harmonics of the ion cyclotron frequency. It is shown theoretically that this 10% frequency shift can be explained as a result of collisions. The theory also relates the width of the resonance to a collision frequency. The waves were launched by a one turn loop around the cylindrical plasma column and damped in a magnetic beach. The plasma was produced from a

5 mTorr initial filling of deuterium or hydrogen gas by special pre-ionization which was followed by an axial current from a ringing capacitive discharge. The magneto-sonic column resonance up through the second radial mode was also observed. A summary of various pre-ionization and turbulent heating schemes which were investigated as plasma sources is also presented.
Dissert. Abstr.

N78-12837 Tennessee Univ., Knoxville.
ON PRESSURE AND HEAT FLUX DISTRIBUTION ALONG MAGNETOHYDRODYNAMIC GENERATOR CHANNEL-DIFFUSER SYSTEMS Ph.D. Thesis
Gabriel Davis Roy 1977 154 p
Avail: Univ. Microfilms Order No. 77-16598

The pressure distribution was investigated along supersonic magnetohydrodynamic (MHD) generators resulting from the interfractions of Lorentz force and Joule heating with the flow. The pressure recovery of diffusers under conditions pertinent to MHD generators was also studied. Static pressure and voltage measurements were made in diagonal conducting wall generators. A quasi one-dimensional analysis with friction, heat transfer, chemical reaction, and normal shock wave is made. The voltage distribution is predicted accurately by the analysis and so is the pressure distribution where the flow is shock-free. Investigations were made of both supersonic and subsonic diffusers with coal combustion gas with high entrance boundary layer blockage factors in the subsonic diffuser. Pressure recoveries and heat transfer rates are presented. Dissert. Abstr.

N78-12838# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
A CONTRIBUTION TO THE THEORY OF IONIZATION WAVES IN THE POSITIVE COLUMN OF A GLOW DISCHARGE
K. Kolacek 2 Feb. 1977 15 p Transl. into ENGLISH from Czech. J. Phys. (Czechoslovakia), v. 16, 1966 p 221-227
(AD-A044152; FTD-ID(RS)I-1826-76) Avail: NTIS HC A02/MF A01 CSCL 20/3

The energy averaging of the Boltzmann-Vlasov kinetic equation is performed for small discharge currents in a one-dimensional approximation on the assumption that the velocity distribution of the electrons is near to the Maxwell distribution.
Author (GRA)

N78-12839# Commissariat a l'Energie Atomique, Villeneuve-Saint-Georges (France).
PLASMA FOCUS
Alain Bernard, Alain Jolais, Jean-Pierre Garconnet, Jean DeMascureau, Christian Nazet, Alain Coudeville, and Andre Bekiarian Jan. 1977 105 p refs In FRENCH; ENGLISH summary
(CEA-R-4807) Avail: NTIS (US Sales Only) HC A06/MF A01; ERDA Depository Libraries

Results are given from experiments concerning plasma focus interferometry, laser scattering, electric and magnetic-measurements, X-ray and neutron emission and also the possible use of explosive current generators instead of capacitor banks at high energy levels. ERA

N78-12840# Oak Ridge National Lab., Tenn.
NEOCLASSICAL TRANSPORT IN AN ELLIPTIC TOKAMAK
K. T. Tsang Apr. 1977 21 p refs
(Contract W-7405-eng-26)
(ORNL/TM-5631) Avail: NTIS HC A03/MF A01

Neoclassical transport for an elliptic Tokamak in all collisional regimes is investigated by the technique of partitioning the velocity space. It is found that in a Tokamak of moderate elongation, particle and ion heat confinement times are increased by a factor of sigma squared, where sigma is the ratio of vertical minor radius to horizontal minor radius. Ripple diffusion in an elliptic Tokamak is also studied. Ion heat conductivity due to ripples is reduced by a factor of approximately sigma squared.
ERA

N78-12841# Association Euratom-CEA, Fontenay-aux-Roses (France). Dept. de Physique du Plasma et de la Fusion Controlee.
RESPONSE OF CONFINED PLASMAS TO INJECTION OF MATTER
G. Cissoko (CISI) and R. Papoular Dec. 1976 33 p refs
(EUR-CEA-FC-866) Avail: NTIS (US Sales Only) HC A03/MF A01; ERDA Depository Libraries

The dynamics of high temperature, magnetically confined plasma components is described by means of a model incorporating classical friction between ions of the same, as well as different, atomic species. Anomalous diffusion is represented in the general flux expression by a phenomenological, additive term, proportional to the density of the species considered. The proper choice of a single, empirical, diffusion coefficient, common to all the species, allows this model to reproduce, at least qualitatively, many features of the density behavior observed in experiments involving injection of matter into plasma vessels: possibility of a steady-state, density and flux profiles, particle life-time, mean-density response time, difference in behaviour of ions of low and high charge numbers, and velocity and range of penetration of injected impurity atoms. Quantitative information is delivered by a numerical code accepting arbitrary temperature, current and magnetic field profiles as input data. ERA

N78-12842# Association Euratom-CEA, Fontenay-aux-Roses (France). Dept. de Physique du Plasma et de la Fusion Controlee.
NONLINEAR LANDAU EFFECT IN THE CASE OF AN ELECTRON PLASMA WAVE SPECTRUM Ph.D. Thesis
Francoise Gervais Dec. 1976 241 p refs In FRENCH
(EUR-CEA-FC-869) Avail: NTIS (US Sales Only) HC A11/MF A01; ERDA Depository Libraries

A broad wave-band spectrum of 'electron-plasma' type interacting with an argon plasma column was investigated. The experimental conditions induce a relaxation dispersion preventing any phenomenon of three wave resonance coupling. The spectrum is shifted towards low frequencies; plasma noise waves, with frequencies below that of the injected spectrum, grow when the observation distance increases, or when the power injected in the spectrum becomes more important. A comparison of theoretical and experimental results is deduced from a numerical calculation of the terms of the equation of spectrum evolution (Vlasov-Poisson equation) which takes account for initial conditions. A good agreement is obtained except for a very restricted zone where a four wave coupling appears. The theory predicts the creation of beating waves with a phase velocity to the group velocity of the spectrum waves. The property of spatial conservation of the plasmon flux is experimentally verified. ERA

N78-12843# Association Euratom-CEA, Fontenay-aux-Roses (France). Dept. de Physique du Plasmaet de la Fusion Controlee.
CORRELATED PROPAGATORS AND AVERAGE TRAJECTORIES IN TURBULENT PLASMAS
J. H. Misguich and R. Balescu Nov. 1976 63 p refs
(EUR-CEA-FC-854) Avail: NTIS (US Sales Only) HC A04/MF A01; ERDA Depository Libraries

Average trajectories were systematically studied in the kinetic limit of long times and the weak coupling approximation in order to deduce the asymptotic behavior of spatial and velocity diffusion processes. Forward and backward evolutions in time were considered, as well as individual and correlated trajectories to prove the equivalence between the weak coupling approximation used in the propagator formalism of plasma turbulence with the Dupree-Weistock approximation of the truncated cumulant expansion. It is proved that the turbulent propagator previously calculated represents a double cumulant expansion in the positions and velocities, along with the crossed term usually neglected. For correlated trajectories, analogous results were derived. The spatial relative diffusion associated with the correlated binary propagator (appearing in the kinetic theory of turbulent correlations and clump effects) is discussed. This correlated propagation is calculated. The result obtained for spatial diffusion differs from Dupree's result. ERA

76 SOLID-STATE PHYSICS

Includes superconductivity.

For related information, see also *33 Electronics and Electrical Engineering* and *36 Lasers and Masers*.

N78-12844 Institute of Paper Chemistry, Appleton, Wis.
THE INFLUENCE OF MOLECULAR STRUCTURE OF VAPOR PHASE CHEMISORBED FATTY ACIDS PRESENT IN FRACTIONAL MONOLAYER CONCENTRATIONS ON THE WETTABILITY OF CELLULOSE FILM Ph.D. Thesis
Ronald E. Swanson 1976 157 p
Avail: Univ. Microfilms Order No. 77-17250

The relationship was examined between the quantity of several fatty acids present in fractional monolayer concentrations and the resultant change in wettability of a cellulose film surface containing fatty acid chemisorbed from the vapor phase. The quantity of chemically bonded (ester bonding) fatty acid determined the magnitude of the contact angle, even though the physically adsorbed species were generally present in much higher concentrations. Behenic acid decreased the wettability of the cellulose film more efficiently than either stearic acid or isostearic acid. It was hypothesized that the chemisorbed molecules sweep out an area far greater than their cross-sectional area. An empirical relationship was obtained from the conceptual model of swept-out areas which related the water contact angle to the product of the quantity chemisorbed and the square of the molecular chain length of the adsorbate. This equation provided a quantitative relationship between fractional surface coverage and wettability for the adsorbate-adsorbent system. Dissert. Abstr.

N78-12845 Iowa State Univ. of Science and Technology, Ames.
NUCLEATION AND DYNAMICS OF VORTICES IN TYPE-II SUPERCONDUCTORS Ph.D. Thesis
Robert E. Ballay 1977 126 p
Avail: Univ. Microfilms Order No. 77-16950

The one- and two-dimensional Ginzburg-Landau equations are numerically integrated in a slab geometry, which is appropriate for comparison to experimental work done on films. When two-dimensional variations become energetically favorable, a vortex is found to nucleate and move to the center of the film. There is a savings in condensation energy arising from the shrinking size of the vortex core as it moves to the center of the film. The solutions of the Ginzburg-Landau equations are used to explain anomalies observed experimentally in the tunneling characteristics of thin films of PbIn. Excellent agreement between theory and experiment is found with the Ginzburg-Landau equations. We then use the Clem model of an isolated vortex to model vortex nucleation and dynamics under the influence of a transport current. The entry fields predicted by the model are found to be off by almost a factor of two but have the advantage of requiring simpler computer programs. Dissert. Abstr.

N78-12846 Georgetown Univ., Washington, D.C.
ANISOTROPY AND MULTI-BAND EFFECTS IN WEAK-COUPLING SUPERCONDUCTORS Ph.D. Thesis
Thomas Lee Berger 1977 146 p
Avail: Univ. Microfilms Order No. 77-16852

The techniques of second quantization and thermodynamic Green functions are used to investigate energy gap anisotropy and multi-band effects in pure single-crystal, weak-coupling superconductors. It is shown that the interband gap parameter, which is coupled to the usual gap parameter by the Green functions equations of motion, can only contribute indirectly to the tunneling electric current and thermodynamic potential. An essentially temperature independent anisotropy function which contains all angular dependence of the gap is shown to evolve naturally from this formalism. The overall temperature dependence of the gap is investigated and it is found that with a change of temperature, the magnitude of the gap in different directions changes in the same ration. The ordinary Markowitz-Kadanoff model is shown to be inappropriate for the case of a multi-band superconductor and a generalized version of this model is introduced and discussed. Dissert. Abstr.

N78-12847 Purdue Univ., Lafayette, Ind.
THE EFFECTS OF ELASTIC DEFORMATION ON THE ELECTRICAL RESISTIVITY OF TITANIUM SESQUIOXIDE (Ti2O3) IN THE SEMICONDUCTING AND IN THE SEMICONDUCTOR-SEMIMETAL TRANSITION REGIONS Ph.D. Thesis
Hsiao-ling S. Chen 1976 109 p
Avail: Univ. Microfilms Order No. 77-15391

The effect of uniaxial compression on the resistivity of single crystal Ti2O3 samples with several different crystallographic orientations was measured for several temperatures between 77 K and 500 K. The effect of hydrostatic pressure was determined over a more limited temperature range (77 K to 400 K). At low temperatures (77 K to 300 K) the effects are due mainly to a redistribution of electrons accompanying the stress induced change of the energy gap between valence and conduction bands. At high temperatures (300 K to 500 K transition temperature region) a large, almost cusp-like extremum was observed for each piezoresistance measured using uniaxial stress. These extrema cannot be explained as the approaching and finally overlap of the two Ti 3d subbands as temperature increases. The most likely explanation involves a change of mobility due to strain causing appropriate modifications of the frequency of a soft phonon mode at various temperatures. Dissert. Abstr.

N78-12848 North Carolina Univ., Chapel Hill.
SPECTRAL DIFFUSION IN VANADIUM DOPED RUTILE Ph.D. Thesis
Gerard Charles Chingas 1976 194 p
Avail: Univ. Microfilms Order No. 77-17416

A two pulse electron-spin echo experiment was performed on a .50% TiO2V(4+) system in the temperature range between 4K deg and 40K deg. The temperature dependent echo envelope decay is discussed in terms of the spectral diffusion theory in which spin-lattice induced dipolar motion is identified as the primary decay mechanism. The phase memory time was generally found to be a monotonically decreasing function of temperature although anomalies indicative of motional narrowing were found at temperatures between 15K deg and 20K deg. Instantaneous diffusion effects for short pulses are also observed and discussed. Theoretical expressions are obtained for the echo envelope in terms of a spin-spin correlation function. Under restricted conditions, the echo envelope shape can be interpreted as the free induction decay of a narrowed line related in a simple way to the conventional absorption line observed in low power CW studies. Dissert. Abstr.

N78-12849 Purdue Univ., Lafayette, Ind.
ULTRASONIC ABSORPTION AND VELOCITY STUDIES OF AMORPHOUS ARSENIC TRI-SELENIDE AND THERMAL EXPANSION OF AMORPHOUS ARSENIC TRI-SELENIDE AND ARSENIC TRI-SULFIDE Ph.D. Thesis
Thomas Nelson Claytor 1976 141 p
Avail: Univ. Microfilms Order No. 77-15392

The attenuation of longitudinal ultrasonic waves with frequencies between 90 MHz and 270 MHz was measured for amorphous AS2SE3 between 1.5 K and 300 K. Attenuation of shear waves was also measured at room temperature and between 1.5 K and 90 MHz and 30 MHz. The magnitude and frequency dependence of the attenuation is generally greater for higher temperatures. The attenuation versus temperature data show a shoulder between 3 K and 4 K, and in some samples a very small, very broad maximum centered near 20 K. These results indicate the presence of two types of relaxation processes in the low temperature region (1.5 K to 60 K) which are associated with thermal phonon-assisted tunneling of atoms between alternative sites describable by the double-potential-well model of glasses. Thermal expansion measurements on a-AS2SE3 and a-AS2S3 were made between 20 and 300 K which reveal positive expansion coefficients at all temperatures. Dissert. Abstr.

N78-12850 Missouri Univ., Columbia.
LATTICE DYNAMICS OF NICKEL OXIDE Ph.D. Thesis
Richard Allen Coy 1976 119 p
Avail: Univ. Microfilms Order No. 77-15502

The phonon dispersion relations for NiO have been measured in the three high symmetry directions [100], and [110], and [111] using coherent inelastic neutron scattering. Experimental data were taken both above (T = 600 K) as well as below (T = 293 K) and Neel temperature (Tn = 532 K). A limited number

of magnons were examined and were found to be in excellent agreement with published results. The room temperature phonon data were interpreted in terms of various shell models based on the Born-von Karman theory of lattice dynamics. However, discrepancies were observed between the initial slopes of the acoustic branches determined in these measurements and those calculated from published ultrasonic data. The frequency distribution fu..tion was calculated and used to determine the temperature dependence of the lattice specific heat and the Debye temperature. Comparison with experimental specific heat data allows the separation of the magnetic contribution.

Dissert. Abstr.

N78-12851 California Univ., Berkeley.
CRITICAL VELOCITIES AND ION-TRAPPING LIFETIMES OF VORTEX LINES IN ROTATING SUPERFLUID HELIUM Ph.D. Thesis
Keith Thomas DeConde 1976 56 p
Avail: Univ. Microfilms Order No. 77-15659

Two experiments on quantized vortex lines in rotating superfluid helium are described. The lines are detected by trapping negative ions on them and then extracting the ions and measuring the total trapped charge. The critical velocities for vortex formation are measured in cylinders of circular, elliptical, and rectangular cross-section. The results are in good quantitative agreement with theoretical calculations based on equilibrium thermodynamics. The halflife for electrons to remain trapped on vortex lines is measured for 1.7K greater than T greater than 1.1K. For T less than 1.5K, this lifetime is affected by several factors which should have no influence on the intrinsic ion-vortex interaction. Observations strongly indicate that the vortex lines move in the rotating container, and the trapped charge escapes when the vortex lines interact with the container wall. Dissert. Abstr.

N78-12852 California Inst. of Tech., Pasadena.
MICROWAVE IMPEDANCE OF SUPERCONDUCTING WEAK LINKS, 1. EFFECTS OF NONEQUILIBRIUM QUASIPARTICLE DISTRIBUTIONS IN SUPERCONDUCTING WEAK LINKS, 2 Ph.D. Thesis
James Dean Franson 1977 318 p
Avail: Univ. Microfilms Order No. 77-17262

Nonequilibrium properties of proximity coupled superconducting weak links are studied. The impedance of a current-biased weak link was calculated analytically on the basis of several different theoretical models for the supercurrent and the quasi-particle current, and the results were compared with experimental measurements. A very small tunnel junction was used to inject quasi-particles directly into the center of a proximity effect weak link. It was found that the critical current of the weak link was, over a wide range of experimental conditions, proportional to (-alpha square root of P), where P is the injection power and alpha is a constant. The final experiment consisted of using a small tunnel junction as a probe of the nonequilibrium quasi-particle chemical potential inside a proximity effect weak link. The nonequilibrium value of potential was produced by simultaneously passing a dc bias current and a microwave current through the weak link. For most values of microwave current measured value of the quasi-particle chemical potential was proportional to the dc supercurrent carried by the weak link.

Dissert. Abstr.

N78-12853 American Univ., Washington, D. C.
SEPARATION OF PYROELECTRIC CURRENTS AND THERMALLY STIMULATED CURRENTS IN POLY (VINYLIDENE FLUORIDE) Ph.D. Thesis
Lynn Edwin Garn 1977 145 p
Avail: Univ. Microfilms Order No. 77-16816

Pyroelectric currents and thermally stimulated currents in poly(vinylidene fluoride) polymer (PVF2) were studied. PVF2 samples were oriented with high electric fields and then were heated at a constant rate. On the first thermal cycle the current was large and irreversible, a characteristic of thermally stimulated current. On the second and subsequent thermal cycles, the current was reversible and reproducible, a characteristic of pyroelectric current. Several experiments were performed to determine the fraction of pyroelectricity present in the first thermal cycle. The experimental results indicate that the first thermal cycle contains up to about 50% more pyroelectricity than the second and subsequent cycles. Measurements made with the sinusoidal temperature technique indicate that most of the first thermal cycle current is nonpyroelectric. Dissert. Abstr.

N78-12854 Rochester Univ., N. Y.
SUPERCONDUCTIVITY IN TRANSITION-METAL GERMANIUM SYSTEMS Ph.D. Thesis
Arup Kumar Ghosh 1977 106 p
Avail: Univ. Microfilms Order No. 77-16227

The variation in the superconducting properties of various binary alloys of transition metal-germanium systems was surveyed by studying sputter deposited samples prepared under various conditions. RF co-sputtering was used to form compounds. The primary focus of the study was the formation of the stoichiometric A-15 compounds T3Ge (where T represents a transition metal, Y, La, Ti, Zr, Hf, V, Nb, Ta, Mo, W, and Re). While sputtered V3Ge had Tc sub close to bulk values, Nb3Ge and Mo3Ge showed a considerable enhancement in Tc over the bulk values. Trends in Tc sub and a sub o, the A-15 lattice parameter, indicate that metastable Nb3Ge was formed in the 'correct' stoichiometric A-15 structure. The importance of the sputtering parameters such as the substrate temperature T sub s, the bias voltage and gas pressures on the formation of A-15 Nb3Ge was observed. Dissert. Abstr.

N78-12855 Catholic Univ. of America, Washington, D. C.
CALCULATION OF ENERGY LEVELS OF THE GROUND CONFIGURATION OF TRIPLY IONIZED RARE EARTHS IN A CRYSTALLINE ELECTRIC FIELD; APPLICATION TO TRIPLY IONIZED NEODYMIUM IN THE BROMATE CRYSTAL Ph.D. Thesis
Georgia Ann Martin 1977 175 p
Avail: Univ. Microfilms Order No. 77-15932

Crystal field theory is applied to the calculation of energy levels of the ground configuration of triply ionized rare earths in crystals. Two schemes are illustrated: The Gel'fand basis, which labels the states by a canonical chain of unitary groups, and the tableaux basis, which labels the states by Young tableaux. The one-to-one correspondence between the two labeling schemes is illustrated. A complete listing of FORTRAN programs which are applicable to a congifuration of any number of equivalent f electrons is presented, along with a short description of each. Application is made to the calculation of energy levels of Nd3+ in the bromate crystal. Dissert. Abstr.

N78-12856 California Univ., San Diego.
THE EFFECT OF CRYSTALLINE ELECTRIC FIELDS AND LONG-RANGE MAGNETIC ORDER ON SUPERCONDUCTIVITY IN RARE EARTH ALLOYS AND COMPOUNDS Ph.D. Thesis
Ralph William McCallum 1977 173 p
Avail: Univ. Microfilms Order No. 77-17193

In the singlet ground state system (LaPr)Sn3, the superconducting and normal state properties of a superconducting host containing a magnetic rare earth impurity with crystalline field split 4f energy levels was studied in detail. Measurements are in excellent agreement with the theory of Fulde and coworkers and evidence is present for the existence of superconducting electron pairing resulting from inelastic Coulomb scattering from the Pr(3+)4f electron shell. In the rare earth (RE) molybdenum chalcogenides, RExMo6-Se8 and RExMo6S8, the rare earth ions completely occupy translationally invariant sites in the lattice. Evidence is presented for the coexistence of long-range antiferromagnetic order and superconductivity in the compounds Gd1.2Mo6Se8, Tb1.2Mo6Se8 and Er1.2Mo6Se8. In addition phase transitions of unknown origin were observed in the superconducting state for Gd1.2Mo6Se8, Tb1.2Mo6Se8, Dy1.2Mo6Se8 and Sm1.oMo6Se8. Dissert. Abstr.

N78-12857 Purdue Univ., Lafayette, Ind.
EXPERIMENTAL AND THEORETICAL CHARACTERIZATION OF DEFECTS ASSOCIATED WITH RADIATION DAMAGE AND RADIATION ANNEALING IN n-TYPE SILICON Ph.D. Thesis
Kenneth Allan Ports 1976 257 p
Avail: Univ. Microfilms Order No. 77-15455

Effects produced by irradiating medium resistivity n-type silicon with 1 MeV and 300 KeV electron at temperatures from

36 K to 80 K were investigated. The dc electrical conductivity and Hall coefficient of 100 micron thick pulled and float zone material were measured as functions of time, temperature and irradiation conditions. The results are consistent with a model in which 1 MeV irradiation primarily produces displacements, 300 keV irradiation primarily produces ionization, silicon interstitials are mobile at all temperatures, and vacancies are mobile only at temperatures above 70 K. Radiation damage occurs when vacancies can migrate to impurities and form defects. Radiation annealing occurs when defects are ionized into instability and then dissociate. Susceptibility to radiation annealing is a function of the characteristics of the defects and of their constituents.
Dissert. Abstr.

N78-12858 Ohio State Univ., Columbus.
ANALYTICAL APPROXIMATIONS TO THE COHERENT POTENTIAL FOR SUBSTITUTIONAL ALLOYS Ph.D. Thesis
Pisistha Ratanavararaksa 1977 149 p
Avail: Univ. Microfilms Order No. 77-17128

In the Traveling Cluster Approximation (TCA) method of Coherent Potential Approximation (CPA), the graphs of the corrected cumulant expansion are partially summed in such a way that the Herglotz property of the mean resolvent can be analyzed easily at each stage. A single graph in this approximation may induce a sequence of clusters traveling arbitrarily large distances through the sample. The CPA and the single-site TCA are known to be exactly equivalent to each other. The TCA in the level of nearest-neighbor approximation (TCA(nn)) was applied to both two-dimensional and three-dimensional alloys in the single-band calculation, with nn interaction, and site diagonal disorder only. The TCA(nn) gives quite satisfactory results when compared with exact calculations for 19 x 20 x 21 site alloys with site diagonal disorder. It gives substructure which does not appear in the results of the CPA, and also gives better band edges of the spectrum. Dissert. Abstr.

N78-12859 California Univ., Berkeley.
RESISTANCE OF SUPERCONDUCTING-NORMAL-SUPERCONDUCTING SANDWICHES Ph.D. Thesis
Michael Lynn Rappaport 1976 188 p
Avail: Univ. Microfilms Order No. 77-15830

The resistance, R, of superconducting-normal metal-superconducting (SNS) sandwiches was measured as a function of temperature, T, and measuring current, I, usually from 20 mK to Tcs. A semi-phenomenological theory for the resistance of these sandwiches below T less than or equal to 1K which includes both temperature and current dependance was derived using the de-Gennes theory of the proximity effect and the idea of Andreev reflection. Comparing experimental and theoretical R vs T curves for T less than or equal to 1K allows us to estimate the magnitude of the induced pair potential in N, delta IV, and then to deduce the values of the BCS interaction parameter (N(0)V]n, where N(0) is the density of states of one spin at the Fermi surface and V is the net electron-electron coupling interaction. The values of (N(0)V)n found for Rh, Cu, and Ag are 0.078 + or - 0.010, 0.045 + or - 0.010, and 0.015 + or - 0.005, respectively. Dissert. Abstr.

N78-12860 Kansas Univ., Lawrence.
K-SHELL X-RAY PRODUCTION WITH NITROGEN AND OXYGEN IONS ON THICK TARGETS OF ALUMINUM, TITANIUM, AND NICKEL Ph.D. Thesis
Donald Leonard Jackson 1976 112 p
Avail: Univ. Microfilms Order No. 77-16280

The K-shell X-ray production cross sections for aluminum, titanium, and nickel bombarded with mass 14 nitrogen and mass 16 oxygen signly-charged ions were determined. The oxygen-aluminum cross sections were found to be three times larger than the nitrogen-aluminum cross sections at the same ion velocity. This is opposite to the cases of nitrogen-titanium and nitrogen-nickel where the nitrogen cross sections were determined to be twice as large as the corresponding oxygen cross sections. The plane wave Born approximation theory was able to reproduce well all of the titanium and nickel cross sections, but was unable to predict the aluminum cross sections, being one-hundred times smaller than the experimental values. It also predicted a reversed oxygen to nitrogen cross section ratio compared to that which was determined. Dissert. Abstr.

N78-12861 Tennessee Univ., Knoxville.
NEON CHARACTERISTIC X-RAY PRODUCTION IN NEON-NEON COLLISIONS Ph.D. Thesis
Randolph Stuart Peterson 1977 102 p
Avail: Univ. Microfilms Order No. 77-16595

Neon K X-ray production cross sections from neon-neon collisions were measured for beam energies between 40 keV and 300 keV. The charge state and mass dependencies of these cross sections were compared with molecular orbital theoretical models. Monotonic increase in inner-shell vacancy production cross sections with the number of initial 2p vacancies in the incident neon projectile, predicted by all molecular orbital model theories were verified for incident charge states one through five for Ne + or - Ne collisions. Exact quantitative comparisons of the K X-ray production cross sections with theoretical K-vacancy production cross sections were impeded by ambiguities in the average fluorescence yields. Nevertheless the K X-ray production cross sections indicated either a significant departure from theoretical predictions, or demonstrated a significant collision-averaged fluorescence yield dependent on the incident projectile charge state. Dissert. Abstr.

N78-12862 California Univ., Berkeley.
INTEGRATED-OPTICS THIN-FILM DEVICES Ph.D. Thesis
Cheng-Chung Tseng 1976 123 p
Avail: Univ. Microfilms Order No. 77-15888

Passive and active thin-film devices which are amenable to future laser beams circuitry were investigated. A preferential etching technique was developed and applied to the fabrication of a thin-film prism, channel waveguides and optical bends and rings. A scheme of incorporating a Schottky-Barrier photodetector with a channel waveguide was proposed and experimentally demonstrated, and the wave propagation problem in a periodic structure by Bloch wave approach was analyzed. Threshold condition for a thin-film distributed Bragg-reflector (DBR) laser has been derived. A numerical example is given. Thin-film GaAs DBR lasers were fabricated by using the liquid-phase-epitaxial technique to form the double-layered GaAs-(GaAl)As waveguide. Grating reflectors are made by chemical etching through a photoresist grating mask. The determination of Bragg scattering effect of the grating reflector is made by correlating lasing wavelength with the corrugation period and by evaluating longitudinal mode spacings. General characteristics of the DBR lasers agree well with the theoretical analysis. These thin-film GaAs DBR lasers are ideal laser sources for integrated optics.
Dissert. Abstr.

N78-12863 Kentucky Univ., Lexington.
TRANSIENT PHOTOCONDUCTIVITY STUDIES IN AMORPHOUS AND CRYSTALLINE ORGANIC SOLIDS Ph.D. Thesis
Kenti Takahashi 1976 170 p
Avail: Univ. Microfilms Order No. 72-15977

Transient photoconductivity studies were carried out on amorphous films of poly (N-vinylcarbazole) (PVK) and a PVK mixture with trinitrofluorenone (TNF) to obtain information about hole and electron trapping. Transient photoconductivity studies on polydiacetylene single crystals were also carried out in order to assess any effects of crystallinity on the measured electronic properties. The transient photoconductivity experiments on amorphous films of PVK and PVK:TNF mixtures under space charge free conditions revealed the presence of deep hole and electron traps. The voltage and thickness dependence of the initial current in the space charge free photocurrent transient is explained in terms of the field dependence of the carrier generation and transport processes. An investigation of transient photoconductivity in films of PVK has shown that photoinduced charge transfer, leading to hole injection into the polymer film, takes place with photons of energy greater than approx. 2 eV.
Dissert. Abstr.

N78-12864 Vanderbilt Univ., Nashville, Tenn.
ELECTRICAL TRANSPORT AND MICROSTRUCTURAL PROPERTIES OF SEMICONDUCTING FeO-Fe2O3-MnO PHOSPHATE GLASSES Ph.D. Thesis
James Granville Vaughan 1976 148 p
Avail: Univ. Microfilms Order No. 77-16085

Iron manganese phosphate glasses of the type, x(FeO - Fe2O3)

y(MnO) (100 - x - y)P2O5 were prepared with x ranging from 20 to 75 mole percent and y ranging from 0 to 50 mole percent. Manganese was determined to be present in the Mn 2+ state with iron as Fe 2+ and Fe 3+. The dc conduction process in these glasses is consistent with the theory of small polaron hopping: although at high transition metal ion concentrations, microstructural effects control the observed conductivity. Manganese as Mn 2+ does not take an active part in the conduction process. Theoretical and experimental agreement between Seebeck and conductivity data is evident. Electron correlation effects due to high polaron densities, magnetic coupling, and iron manganese phosphate-like structural formations in these glasses must be considered. A simple formulism for conduction is advanced and trends correctly predicted.
Dissert. Abstr.

N78-12865 California Univ., Berkeley.
ELECTRONIC STRUCTURE OF METALS AND SEMICONDUCTORS: BULK, SURFACE, AND INTERFACE PROPERTIES Ph.D. Thesis
Steven Gwon Sheng Louie 1976 265 p
Avail: Univ. Microfilms Order No. 77-15771

The atomic structures of Cs, Si, Nb, GaAs, ZnSe, and ZnS were investigated with emphasis on the properties of these materials when subjected to extreme conditions, and in various configurations. The excitonic mechanism of superconductivity and the role of local fields are discussed. A method using pseudopotentials to describe nonperiodic systems was developed and applied to localized configurations such as molecules, surfaces, impurities, vacancies, finite chains of atoms, adsorbates, and solid interfaces. A model involving metal-induced states in the semiconductor band gaps near the interfaces is presented for the ionicity-dependent behavior of the metal-semiconductor Schottky barrier heights. The electronic structure of a neutral vacancy in silicon crystal is calculated. Dissert. Abstr.

N78-12866 California Univ., Berkeley.
ELECTRON DAMAGE AND DEFECTS IN ORGANIC CRYSTALS Ph.D, Thesis
David George Howitt 1976 76 p
Avail: Univ. Microfilms Order No. 77-15719

The nature of the defects discernable from, and the radiation damage that is induced by, high resolution electron microscopy is reported. The structural aspects of the radiation damage process are correlated with the expected radiochemical decomposition of these materials and the types of local defect formed by radiation damage are distinguishable, in high resolution images, from those inherent in the microstructure. The particular techniques used in this type of electron microscopy and the limitations imposed by radiation damage are described as are the relevant radiochemical characteristics of these processes. Microstructural features distinct from those induced by radiation damage were identified in copper pthalocyanine. Dissert. Abstr.

N78-12867*# National Aeronautics and Space Administration, Washington, D. C.
EFFECT OF TEMPERATURE ON THE ELECTRONIC INSTABILITY AND THE CRYSTALLINE PHASE CHANGE AT LOW TEMPERATURE OF V3Si TYPE COMPOUNDS
J. Labbe and J. Friedel Nov. 1977 13 p refs Transl. into ENGLISH from J. Phys. (Paris), v. 27, no. 5-6, May-Jun. 1966 p 303-308 Transl. by Kanner (Leo) Associates, Redwood City, Calif. Original doc. prep. by Coll. of Sci., Orsay (France)
(Contract NASw-2790)
(NASA-TM-75179) Avail: NTIS HC A02/MF A01 CSCL 20L

Equations assuming a Jahn-Teller type effect for the d band electrons in V3Si compounds are given, and the results of free-energy change calculations by using some approximations based on these equations are depicted. The tetragonal structure is converted to cubic as the temperature rises past T sub m which is calculated as 13 K. by the Batterman-Barrett method and is measured to be 20-5 K. Other parameters such as change of C sub p with temperature are predicted better. Author

N78-12868*# National Aeronautics and Space Administration, Washington, D. C.
A METHOD FOR INDEXING X-RAY POWDER PHOTOGRAPHS
G. Gattow and H. Piotter Oct. 1977 13 p refs Transl. into ENGLISH from Z. Anorg. Allg. Chem. (East Ger.), v. 336, no. 1-2, Mar. 1965 p 1-10 Transl. by Sci. Transl. Serv., Santa Barbara, Calif.
(Contract NASw-2791)
(NASA-TM-75167) Avail: NTIS HC A02/MF A01 CSCL 20B

A graphical method of indexing X-ray powder photographs without the use of single crystal data is described. Author

N78-12869# Utah Univ., Salt Lake City. Dept. of Mathematics.
ELECTROMAGNETIC SIGNAL PROPAGATION IN CRYSTALS
Calvin H. Wilcox Jun. 1977 22 p refs
(Contract N00014-76-C-0276; NR Proj. 041-370)
(AD-A044062; TR-33) Avail: NTIS HC A02/MF A01 CSCL 20/14

The propagation of the electromagnetic signals generated by localized electromagnetic current distributions in perfect crystals is analyzed under the hypotheses that dispersion and magnetic anisotropy are negligible and all wavelengths are large compared with interatomic distances. The signal fields are shown to converge asymptotically in energy, for t approaching infinity, to the sum of two waves which propagate outward from the source region with the group velocities of the crystal. The polarizations and waveforms of these waves are calculated explicitly in terms of the crystal parameters and the source field. Author (GRA)

N78-12870# Utah Univ., Salt Lake City. Dept. of Mathematics.
THEORY OF BLOCH WAVES
Calvin H. Wilcox May 1977 40 p refs
(Contract N00014-76-C-0276; NR Proj. 041-370)
(AD-A044033; TR-32) Avail: NTIS HC A03/MF A01 CSCL 20/12

The Bloch waves of the one electron theory of electronic states in crystals are the eigenfunctions of a family of unbounded selfadjoint operators H(p) that depend holomorphically on the wave momentum p=(p1,p2,p3) elements of R cubed. H(p) has a discrete spectrum, with corresponding complete orthogonal sequences of eigenfunctions, denoted as Bloch waves. The eigenfunctions are not unique and a separate choice is required for each p. The customary definition provides no information about the p-dependence of the Bloch waves. A minimal requirement is p-measurability. Methods for measuring p are discussed, the classical theory of Fredholm minors is used to construct families of Bloch waves which are holomorphic on the complements of a closed nullset. GRA

N78-12871# Illinois Univ., Urbana-Champaign. Coordinated Science Lab.
FAULT DIAGNOSIS OF SEMICONDUCTOR RANDOM ACCESS MEMORIES M.S. Thesis
Satish Mukund Thatte May 1977 73 p refs
(Contract DAAB07-72-C-0259)
(AD-A044281; R-769; UILU-ENG-77-2216) Avail: NTIS HC A04/MF A01 CSCL 09/5

This report deals with the problems of testing semiconductor random access memories and of locating faults on a memory board. Memory test procedures can be divided into three classes, functional testing, pattern sensitivity testing and DC parametric testing. Existing test procedures for testing semiconductor memories are either limited in their fault coverage or require a prohibitive amount of time. A new functional test procedure based on a fault model that takes into account a large variety of faults encountered with semiconductor memories is presented. The fault model is not based on the 'gate' level as in classical fault diagnosis but is formulated on a higher level in terms of functional blocks, like the decoder and the memory cell array. The proposed functional test procedure takes O(n x log sub 2) units of time where n is the number of words in memory. This gives a dramatic improvement in the testing time required over well-known test procedures line 'galpat' and 'Walking Ones' which take O(n squared) units of time. Algorithms for the functional test procedure are given. The problem of locating faults on a memory board to memory chips, decoder logic, data registers, and bussing structure is discussed. A test scheme for this problem is given. Finally various test procedures presented in

the thesis are evaluated for fault coverage, time requirement and east of implementation. GRA

N78-12872# Naval Surface Weapons Center, White Oak, Md.
THE CRYSTAL STRUCTURE STUDY OF L15B4 Final Report
F. E. Wang, M. A. Mitchell, R. A. Sutula, and J. R. Holden 22 Jun. 1977 43 p refs
(RR0130243)
(AD-A044545; WSWC/WOL/TR-77-84) Avail: NTIS HC A03/MF A01 CSCL 20/2

A study has been made of the crystal structure of Li5B4 by X-ray, neutron powder diffraction techniques and NMR (Nuclear magnetic resonance) measurements. The crystal structure thus determined is rhombohedral (R3) in its short-range ordered state and bcc (I23) in its statistically disordered (long-range) state. The boron atomic arrangement consists of a coplanar triangular cluster of four boron atoms which are situated at the vertices and the center of the triangle. This boron atomic arrangement has no precedent either in metal-borides or boron-hydrides. There is a strong indication that: (1) electrons on the boron atoms at the vertices are partially transferred (approx. 1.3 electrons) to the boron atom at the center of the triangle in Li5B4; and (2) the amount of electron transfer increases with temperature rise. Lithium atoms, on the other hand, cluster in a bitetrahedral form (two tetrahedrons sharing a common face) with five lithium atoms occupying the vertices. This lithium atomic arrangement is in part similar to the hexagonal structure of lithium at low temperature. Author (GRA)

N78-12873# Pennsylvania State Univ., University Park. Dept. of Metallurgy and Materials Science.
CRYSTAL MISMATCH IN ELECTROLUMINESCENT MATERIALS Final Report, 1 Sep. 1975 - 30 Jun. 1977
C. Laird and C. A. B. Ball 31 Aug. 1977 13 p refs
(Contract N00014-76-C-0360)
(AD-A044683; Rept-001-3) Avail: NTIS HC A02/MF A01 CSCL 20/12

The results of studies of interface structure in heterojunctions having near (001) orientations are briefly reported. Observations were carried out by X-ray topography, stress-induced birefringence and transmission electron microscopy and all support glide mechanisms and sources for the origin of the dislocations which compensate the misfit of the epilayer. In order to explore the effects of choosing different orientations on the interface structure, similar studies have been carried out on heterojunctions with 331 and 112 orientation. Preliminary results are reported. Author (GRA)

N78-12874# California Univ., Los Angeles. Dept. of Chemistry.
VARIATIONS IN HOMOGENEOUS FLUORESCENCE LINEWIDTH AND ELECTRON-PHONON COUPLING WITHIN AN INHOMOGENEOUS SPECTRAL PROFILE
Phaedon Avouris, Alan Campion, and M. A. El-Sayed 22 Aug. 1977 13 p refs
(Contract N00014-75-C-0602)
(AD-A044622; TR-27; CONTRIB-3868) Avail: NTIS HC A02/MF A01 CSCL 07/4

The fluorescence line narrowing technique (FLN) is used to determine the homogeneous width of the 5D(0) to 7D(0) resonance fluorescence line of Eu(3-) in an amorphous silicate matrix as a function of laser excitation wavelength and temperature (200-350 K). A smooth increase in delta nu sub hom is observed as the excitation wavelength is decreased across the inhomogeneous profile (excitation of sites of progressively higher average crystal field). The combined temperature and excitation wavelength dependence identify the broadening mechanism as a two-phonon Raman scattering process and suggest that the observed increase of delta nu sub hom with increasing excitation energy is due to stronger electron-phonon coupling at sites of stronger crystal field. Author (GRA)

N78-12875# Massachusetts Inst. of Tech., Cambridge. Dept. of Chemistry.
SYNTHESIS AND X-RAY CRYSTALLOGRAPHIC STRUCTURAL DETERMINATION OF THE ACETYLENE COMPLEX (ETA5-C5H5)2W2(CO)4(C2H2)
David S. Ginley, C. Randolph Bock, Mark S. Wrighton, Beda Fischer (Univ. of Southern Calif., L. A.), and Robert Bau (Univ. of Southern Calif., L. A.) 22 Sep. 1977 20 p refs
(Contract N00014-75-C-0880)
(AD-A044636; TR-10) Avail: NTIS HC A02/MF A01 CSCL 07/3

Reaction of photogenerated (ETA5-C5H5)2W2(CO)4 with acetylene at 25 yields a complex of the formula (ETA5-C5H5)2W2(CO)4(C2H2). The crystal structure of the complex shows it to have a tetrahedrane-like W2C2 core. The C-C bond distance of the C2H2 unit is 1.35 Angstrom which is close to that of ethylene, considerably longer than the 1.20 Angstrom for acetylenes. The W-W distance is 2.973 Angstrom which is approx. 0.25 Angstrom shorter than the W-W distance in (ETA5-C5H5)2W2(CO)6 but longer than that expected for (ETA5-C5H5)2W2(CO)4. Author (GRA)

N78-12876# Army Electronics Command, Fort Monmouth, N. J.
THE COMPLEX COMPLIANCES OF QUARTZ
Arthur Ballato Sep. 1977 14 p refs
(DA Proj. 1T1-61101-A-91A)
(AD-A045046; ECOM-4537) Avail: NTIS HC A02/MF A01 CSCL 20/2

The imaginary part of the complex compliance matrix, denoted as the fluency, is defined, and the elements are computed for alpha-quartz. Its application to low frequency vibrators is discussed. The role of motional time constants in characterizing resonator behavior is also described and applied to the minus 18.5 degree bar. Author (GRA)

N78-12877# Harvard Univ., Cambridge, Mass. Div. of Engineering and Applied Physics.
A STRUCTURAL MODEL FOR THE INTERFACE BETWEEN AMORPHOUS AND CRYSTALLINE Si OR Ge
Frans Spaepen Jul. 1977 37 p refs
(Contract N00014-77-C-0002; NSF-DMR-76-0111)
(AD-A045112; TR-2) Avail: NTIS HC A03/MF A01 CSCL 20/12

A general procedure for building static models of interfaces, which involves a change in phase-specific construction rules at the boundary plane, is outlined. Its application to tetrahedrally coordinated materials shows that an amorphous-crystalline interface model can be created by replacing the 'chair' - type sixfold rings (typical of the crystal) by a mixture of different ones (typical of the amorphous phase). The interface consists of two crystalline and two amorphous layers. The detailed topologies, bond angle distortions, and radial distribution functions for each of the four layers are reported. The surface tension has a large energetic component due to the excess strain energy in both the amorphous and crystalline interface layers. For Ge the estimated surface tension is 0.235J/sq m. This is used to show that the model, which contains no dangling bonds, represents a state of minimum energy. Application to the problem of creating a model for amorphous Ge by connecting randomly oriented crystallites with a random network matrix shows that such a model consists of more than 80% random network. Finally it is pointed out that the interface model is a starting point for a detailed description of the crystallization process. GRA

N78-12878# Airtron, Inc., Morris Plains, N.J. Airtron Div.
THE SINGLE CRYSTAL GROWTH AND LASER ROD FABRICATION OF Nd:YVO4 Interim Report, 1 Jul. 1976 - 1 Jan. 1977
Larry E. Drafall and Roger F. Belt Aug. 1977 49 p refs
(Contract DAAB07-76-C-0908)
(AD-A045092; ECOM-76-0908-1) Avail: NTIS HC A03/MF A01 CSCL 20/5

This project was initiated to investigate the single crystal growth and laser rod fabrication of (100) oriented Nd:YVO4. The desired size and quality of the crystals were obtained most advantageously by Czochralski growth methods. We have utilized RF heated iridium crucibles and commercially developed crystal growth equipment to evaluate rapidly many variables. Two growth stations were used continuously. Author (GRA)

N78-12879# Maryland Univ., College Park. Dept. of Physics and Astronomy.

STUDY OF NOISE AND RELAXATION PHENOMENA IN SOLIDS AT LOW TEMPERATURES Annual Report, 1 Nov. 1976 - 31 Oct. 1977
Wm. S. Davis, D. Gretz, J.- P. Richard, and J. Weber Aug. 1977 35 p refs
(Contract N00014-76-C-0428)
(AD-A045308) Avail: NTIS HC A03/MF A01 CSCL 20/11

A demountable cryogenic installation has been developed for study of noise, relaxation phenomena, and quality factors of materials at low temperatures. A new kind of parametric capacitor accelerometer, and new methods for mounting and isolating crystals are described. Results of measurements at liquid helium temperatures, and a theory of an A. C. pumped parametric capacitor up converter are summarized. Author (GRA)

N78-12880# Raytheon Co., Waltham, Mass.
MANUFACTURING METHODS AND TECHNOLOGY ENGINEERING HIGH EFFICIENCY, HIGH POWER GALLIUM ARSENIDE READ-TYPE IMPATT DIODES Quarterly Progress Report, 1 Jan. - 31 Mar. 1977
H. R. Chalifour and S. R. Steele Apr. 1977 52 p
(Contract DAAB07-75-C-0045)
(AD-A045091; QPR-7) Avail: NTIS HC A04/MF A01 CSCL 09/1

Group B testing of the confirmatory sample diodes was completed during the period, ending that phase of the program. All devices tested met specifications. Data is included herein. The Read profile wafers for the pilot production diodes were fabricated and met specifications. They were delivered to the production line. Wafer characterization data is included herein, as well as evaluation data on the first two wafers subsequent to sample diode assembly on the production line. The fifth X-band life test was completed. The sixth X and Ku-band life tests were also completed. Results are discussed herein.Author (GRA)

N78-12881# Army Electronics Command, Fort Monmouth, N.J. Electronics Technology and Devices Lab.
FORCE-FREQUENCY AND OTHER EFFECTS IN DOUBLY ROTATED VIBRATORS
Arthur Ballato, Theodore Lukaszek, and Errol P. Eernisse Sep. 1977 52 p refs
(DA Proj. 1T1-61101-A-91A)
(AD-A045307; ECOM-4536) Avail: NTIS HC A04/MF A01 CSCL 09/1

Precision frequency control requirements for future digital communicaiton systems require improved crystal resonator performance in a number of aspects. Accordingly, the potential of doubly rotated quartz cuts has begun to be explored. In the neighborhood of the SC-cut a variety of effects having their bases in nonlinear elasticity have been shown, or are predicted, to be improved with respect to corresponding AT-cut value. The static frequency-temperature behavior also shows improvement. This report concerns the force-frequency effect, thus far not investigated in any detail for doubly rotated quartz plate vibrators. It relates initial stress produced by mounting supports to resonance frequency changes; it contributes to long-term aging, and is related to the frequency excursions produced in shock and vibration environments. Author

77 THERMODYNAMICS AND STATISTICAL PHYSICS

Includes quantum mechanics; and Bose and Fermi statistics.

For related information see also *25 Inorganic and Physical Chemistry* and *34 Fluid Mechanics and Heat Transfer*.

N78-12882 Rockefeller Univ., New York.
THE IDEAL BOSE-EINSTEIN GAS, REVISITED Ph.D. Thesis
Robert Michael Ziff 1976 139 p
Avail: Univ. Microfilms Order No. 77-17292

The ideal Bose-Einstein gas bulk behavior including the condensation phenomenon is characterized by the thermodynamical properties, occupations of the states and their fluctuations, and the properties of the density matrices, including the diagonal and off-diagonal long range orders. Particular attention is focused on the difference between the canonical and grand canonical ensembles, and a case is made that the latter does not represent any physical system in the condensed region. The properties in a finite region are also examined to study the approach to the bulk limit and secondly to derive the surface properties such as the surface tension (due to the boundary).
Dissert. Abstr.

N78-12883 Rochester Univ., N. Y.
ON MECHANICAL QUANTUM MEASURING PROCESSES Ph.D. Thesis
Barbara Lu Whitten Wolfe 1977 75 p
Avail: Univ. Microfilms Order No. 77-16257

When a quantum system is measured it changes in a way that is probabilistic and irreversible, usually called the reduction of the wave function. The problem of measurement is to show that a measurement can occur as the result of a deterministic time evolution. The physical requirements for a consistent theory of the quantum measuring process are described and formulated in precise mathematical terms, using the techniques of C-algebras. An exactly solvable model of the interaction between a single spin and an infinite chain of spins is provided. The chain of spins functions as an apparatus to measure the single spin. This interaction fulfills the requirements of the theory in every respect, and thus demonstrates that the class of measuring processes described is not empty. This theory of the quantum measuring process is evaluated. Dissert. Abstr.

N78-12884 North Carolina Univ., Chapel Hill.
A STUDY OF QUANTUM WAVE PACKETS Ph.D. Thesis
Edward A. Olszewski 1976 131 p
Avail: Univ. Microfilms Order No. 77-17358

Electron-proton wave-packets arising from photoionization are studied. Using first-order, time-dependent perturbation theory to describe the interaction of a Gaussion-shaped photon wave-packet (coherence length L approximately 10 cm) ionizing a hydrogen atom, several interesting results are obtained. The energy spread of such wave-packets is negligible. The coherence length of the electron-proton system, Le, is related to that of the photon by Le = L ve/c, where ve is the average speed of the electron-proton system in the center-of-mass system and c is the speed of light. Thus, free wave packets may be of macroscopic dimensions. In addition, a computer program, which displays plane-polar-coordinate functions in either mono or stereo views has been written. Dissert. Abstr.

N78-12885 Purdue Univ., Lafayette, Ind.
THERMOMECHANICAL AND ELECTROMAGNETIC PHENOMENA IN MOVING AND DEFORMABLE MEDIA VIA RELATIVITY Ph.D. Thesis
Anastasius George Youtsos 1976 112 p
Avail: Univ. Microfilms Order No. 77-15492

Several problems on relativistic mechanics and electrodynamics of continuous media were examined. The first problem is that of the relativistic formulation of the thermomechanical and electromagnetic constitutive equations of an optically active viscoelastic dielectric. The approach is based on the restrictions imposed on Admissible Thermodynamic Processes, by the Second Law of Thermodynamics. The propagation of linearly polarized waves through a moving and optically active slab is then studied, and the rotation of the plane of polarization is calculated, on the perturbation technique. The Fizeau experiment for a dispersive fluid of the integral type is studied, calculating the fringe-shift due to the motion of the fluid. Finally the shear of an infinite slab of a Green material is studied. The approach is relativistic and aims at steady-state solutions for the velocity profile. An exact solution is obtained for a slab of Rivlin-Mooney material.
Dissert. Abstr.

N78-12886 Pennsylvania State Univ., University Park.
CHARACTERIZATION AND THERMODYNAMIC CORRELATIONS FOR UNDEFINED HYDROCARBON MIXTURES Ph.D. Thesis
Peir Kuen Huang 1977 133 p
Avail: Univ. Microfilms Order No. 77-17696

A characterization factor defined as I = (n sq 2-1)/(n sq 2+2) where n is the liquid refractive index measured with the sodium D-line at 20 C and 1 atm, was developed to describe the composition and nature of an undefined hydrocarbon mixture. This characterization factor which ranges from 0.22 - 0.26 for paraffins to 0.28 or higher for aromatics also represents the fraction of volume occupied by a molecule and is related to the force interaction between molecules. This physical characteristic makes it useful for correlating various properties. Thermodynamic correlations for predicting heat capacity, enthalpy, and density of undefined hydrocarbon mixtures using the identical approach is used for pure compounds and defined mixtures were accomplished by developing four correlations for ideal gas heat capacity, molecular weight, pseudocritical temperature and pseudocritical pressure. These correlations combined with the Lee-Kesler correlation for pseudoacentric factor can be used to predict heat capacity, enthalpy and density through Pitzer's three-parameter corresponding states approach. Dissert. Abstr

N78-12887 Purdue Univ., Lafayette, Ind.
INVESTIGATION OF THE ENTROPY PRODUCTION EXPRESSION: DEVELOPMENT AND REVIEW OF ITS CONSISTENCY WITH CLASSICAL THERMODYNAMICS AND AN EXAMINATION OF ITS ABILITY TO PREDICT NON-EQUILIBRIUM CONFIGURATIONS Ph.D. Thesis
Jack Wilson Chasteen 1976 327 p
Avail: Univ. Microfilms Order No. 77-15390

The terminology that has developed in the subject area of entropy production is reviewed. Such terms as entropy production, rate of increase of entropy, and so on are considered in some detail. The terms are shown to apply locally but to find meaning vis-a-vis thermodynamics only when applied to closed adiabatic systems. One such system is an isolated system, and the development of operations involving the entropy production expression centers on an isolated system. This system is composed of two subsystems, one which is acting spontaneously (called the reaction system) and one which is acting reversibly (called the surroundings). Dissert. Abstr.

N78-12888*# Maryland Univ., College Park.
CONCEPTS AND METHODS FOR DESCRIBING CRITICAL PHENOMENA IN FLUIDS Final Report
J. V. Sengers and J. M. H. Levelt Sengers (NBS, Washington, D. C.) Sep. 1977 160 p refs
(Grant NGR-21-002-344)
(NASA-CR-149665) Avail: NTIS HC A08/MF A01 CSCL 20M

The predictions of theoretical models for a critical point phase transition in fluids, namely, the classical equation with third degree critical isotherm, that with fifth degree critical isotherm, and the lattice gas, are reviewed. The renormalization group theory of critical phenomena and the hypothesis of universality of critical behavior supported by this theory are discussed. Gravity effects on critical region experimentation in fluids are described. The behavior of the thermodynamic properties and the correlation function is formulated in terms of scaling laws. The predictions of these scaling laws and of the hypothesis of universality of critical behavior are compared with experimental data for one-component fluids, and it is indicated how the methods can be extended to describe critical phenomena in fluid mixtures. For one-component fluids, the scale factor of the correlation length is related to the two scale factors of the thermodynamic functions. The relation between correlation length and equation of state of one-component fluids near the critical point is emphasized. Author

N78-12889# Argonne National Lab., Ill. Chemical Engineering Div.
THEORETICAL CONCEPTS USEFUL IN THE CALCULATION OR STORAGE OF PHASE DIAGRAMS OF IONIC SYSTEMS
Marie-Louise Saboungi and M. Blander Jan. 1977 20 p refs Presented at Workshop on Appl. of Phase Diagrams in Met. and Ceram., Gaithersburg, Md., 10-12 Jan. 1977
(Contract W-31-109-eng-38)
(CONF-770116-1) Avail: NTIS HC A02/MF A01

Equations for the a priori calculation or for the storage of phase diagrams and thermodynamic properties of molten ternary ionic systems are derived from conformal ionic solution theory, which rigorously takes into account the ionic nature of the melts. Thermodynamic functions for ternary ionic systems were derived for cases in which all the cations have the same charge and all the anions have the same charge. From these equations and classical thermodynamic relations, phase diagrams are calculated for the two classes of ternary systems a priori from data on lower order systems. Comparisons of such calculations with experimental data were made for liquidus phase diagrams and miscibility gaps in a number of ternary systems; the agreement was generally very good. ERA

N78-12890# Oak Ridge National Lab., Tenn.
THERMODYNAMIC REPRESENTATIONS OF AMMONIA AND ISOBUTANE
S. L. Milora and S. K. Combs May 1977 103 p refs
(Contract W-7405-eng-26)
(ORNL/TM-5847) Avail: NTIS HC A06/MF A01

Tables of the thermodynamic properties of ammonia and isobutane are presented for the superheated vapor and the saturated liquid and vapor states. The properties were calculated using appropriate analytical pressure-volume-temperature (P-V-T) representations for the fluids in the regions described. The tables cover the approximate range of values of reduced temperatures up to 1.5 and reduced pressure up to 5. ERA

80 SOCIAL SCIENCES (GENERAL)

Includes educational matters.

No abstracts in this category.

81 ADMINISTRATION AND MANAGEMENT

Includes management planning and research.

N78-12891# Stanford Univ., Calif. Dept. of Statistics.
MANAGEMENT STRATEGIES IN FIXED-STRUCTURE MODELS OF COMPLEX ORGANIZATIONS
Crayton C. Walker and Alan E. Gelfand 14 Mar. 1977 32 p refs
(Contracts N00014-76-C-0475; Grant DAAG29-77-G-0031)
(AD-A044899; SU-TR-243) Avail: NTIS HC A03/MF A01 CSCL 12/2

The organizational analogues corresponding to a binary switching net models provide useful insight into the behavior of complex organizational control systems. Imposition of certain types of structure on the responses of elements in a system to their inputs enables control of the overall behavior of such nets to an extent that makes them plausible as real world models. Two such structural concepts are examined, internal homogeneity and forcibility, with respect to their influence on the behavior of individual elements and of the system as a whole. These two concepts are interpreted as managerial strategies, the former being management by exception and the latter being management by priority. Author (GRA)

N78-12892# Massachusetts Inst. of Tech., Cambridge. Operations Research Center.
HIERARCHICAL PRODUCTION PLANNING SYSTEMS
Arnold C. Hax and Jonathan J. Golovin Aug. 1977 37 p refs
(Contract N00014-75-C-0556)
(AD-A045016; TR-135) Avail: NTIS HC A03/MF A01 CSCL 05/1

This report describes the development of hierarchical planning systems to support medium range planning and operational decisions in a batch processing production environment. In this approach, higher level decisions impose constraints to lower level actions, and lower level decisions provide the necessary feedback to reevaluate higher level actions. An analysis of the existing

methodology to design hierarchical production systems is given. Computational results are presented. GRA

N78-12893# Michigan Univ., Ann Arbor. Inst. for Social Research.
FUTURE PERFORMANCE TREND INDICATORS: A CURRENT VALUE APPROACH TO HUMAN RESOURCES ACCOUNTING. REPORT 4: AN EXAMINATION AND EVALUATION OF THE STATISTICAL MODEL
Alan S. Davenport, Jean B. Lapointe, and David G. Bowers Jun. 1977 642 p refs
(Contract N00014-76-C-0362; NR Proj. 156-015)
(AD-A045068) Avail: NTIS HC A99/MF A01 CSCL 05/9

This report uses predictive relationships between the Survey of Organizations and measures of organizational effectiveness established in earlier reports (Pecorella and Bowers, 1976a, 1976b, 1977) (AD's A037 733, A033 608, and A036 907), to develop the formal equations, including parameter values, to be used in the value attribution phase. Preliminary to this a series of issues arising from the theoretical and statistical bases of the current value approach are examined. These include: characteristics of variables to be included in the model, assumptions required for prediction of future performance, extension of the univariate methodology to the multivariate case, and the consequences of applying the methodology to this particular data file, for example, standardization of variables and elimination of outliers. A summary of previous and current analyses is also provided. A particular issue is how well the assumptions underlying the multivariate model are met in this particular data file. Analyses show there is no reason to believe the assumptions of multivariate linearity and normality are not met. Other analyses show that one cannot significantly reduce the number of predictor variables in the model. It is concluded that the presented model is appropriate, and the data set is ready to begin the value attribution steps. GRA

82 DOCUMENTATION AND INFORMATION SCIENCE

Includes information storage and retrieval technology; micrography; and library science.

For computer documentation see *61 Computer Programming and Software*.

N78-12894 Iowa State Univ. of Science and Technology, Ames.
CORRECTNESS IN MULTI-USER HIERARCHICALLY STRUCTURED INFORMATION SYSTEMS Ph.D. Thesis
Alan Francis Sweet 1977 255 p
Avail: Univ. Microfilms Order No. 77-16979

A systematic approach is described for providing a high degree of concurrent access to information in hierarchically structured systems. This approach is intended to be applied to the level processes of hierarchical systems during the design phase and be applied to any hierarchical system which satisfies the given definition and which operates on shared information structures which can be modeled as trees. Information integrity is defined in terms of the operations of the system processes. An algorithm is presented which generates and moves monitor calls for exclusive access in the processes to increase potential concurrency, detect nondeterminate processes, guarantee a deadlock free system, and ensure the information integrity of the higher levels. Some applicable monitors are presented and discussed along with potential implementations. Dissert. Abstr.

N78-12895*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
BIBLIOGRAPHY OF SUPERSONIC CRUISE AIRCRAFT RESEARCH (SCAR)
Sherwood Hoffman Nov. 1977 102 p Supersedes NASA-TM-X-73950; N76-34039
(NASA-RP-1003; L-11603; NASA-TM-X-73950) Avail: NTIS HC A06/MF A01 CSCL 05B

This bibliography documents publications of the supersonic cruise aircraft research (SCAR) program that were generated during the first 5 years of effort. The reports are arranged according to systems studies and five SCAR disciplines: propulsion, stratospheric emissions impact, structures and materials, aerodynamic performance, and stability and control. The specific objectives of each discipline are summarized. Annotation is included for all NASA inhouse and low-number contractor reports. There are 444 papers and articles included. Author

N78-12896# Michigan Univ., Ann Arbor. Coastal Zone Lab.
STATE-OF-THE-ART ON NETWORKING AND REGIONAL SYSTEMS OF INFORMATION MANAGEMENT
Cheryl L. Alexander 1 Dec. 1976 59 p
(Contract NOAA-6-35342)
(PB-270221/5; NOAA-77062732) Avail: NTIS HC A04/MF A01 CSCL 05B

The ultimate success of a library/information network is dependent upon the capacity of qualified personnel to propose, develop, implement, and interpret the services required. Some of the factors to consider when identifying the objectives of a network include: (1) subject areas of interest; (2) qualified recipients of service; (3) format of the content; and (4) means of the service. Efficient use of the financial resources available to a library/information network enhanced by: compatibility with other networks; allocation of functions to centralized and decentralized operations; improving and developing products in an evolutionary fashion; and multiple adaptation of processing effort to provide a variety of products and services from one, single, continuing input procedure. Author

N78-12897# National Library of Medicine, Bethesda, Md.
MEDLARS INDEXING MANUAL (PART 2)
Thelma Charen Aug. 1977 418 p Supersedes PB-207181
(PB-271306/3; NLM-Med-77-05) Avail: NTIS HC A18/MF A01 CSCL 05B

The rules governing the technical analysis and indexing of journals and monographs cited in Index Medicus and other MEDLARS products are presented. The Manual contains sections on the following: Indexing Operation, Depth Indexing, IM Headings and Non-IM Headings, MeSH, Authorities and References, Indexed Citation Form, Review Articles, Citation Types, Check Tags, Qualifiers, General Indexing Principles, Categories A-N and Z, and a complete Index to Parts 1 and 2 of the Manual. (Part 1 of the Medlars Indexing Manual is devoted to general bibliographic principles governing the citation of articles in Index Medicus and other MEDLARS products. It outlines also the form of descriptive indexing of articles and monographs cited). GRA

N78-12898# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
STUDIES OF GEODETIC INFORMATION FLOW CONTENT PASSING THROUGH SOME CONVERSION SYSTEMS
K. Eckes 5 Apr. 1977 15 p refs Transl. into ENGLISH from Geodezja i Kartografia (Poland), v. 25, no. 3, 1976 p 169-175
(AD-A044777; FTD-ID(RS)I-0389-77) Avail: NTIS HC A02/MF A01 CSCL 08/5

This report presents a study on information loss in the automatic conversion of data from one form to another. GRA

N78-12899# Qei, Inc., Bedford, Mass.
REAL-TIME ASSOCIATIVE PROCESSING OF REMOTE-DATA BROADCASTS FROM FULL-TEXT FILES Final Report, Mar. 1976 - Feb. 1977
Abdul K. Ezaz 28 Jan. 1977 149 p refs
(Contract NSF C-76-05503)
(PB-270552/3; QEI-6915) Avail: NTIS HC A07/MF A01 CSCL 09B

Components of a data distribution and search service network having full-text data bases, mass storage devices, high bandwidth microwave communications, and associative processors were studied. Performance characteristics of component systems were evaluated and operational characteristics of a network model were derived. Hardware, system requirements, and options for user/network interface and end product distribution schemes were determined. Benefits of an optimal associative processing network include: (1) faster, improved access; (2) information retrieval cost and time reduction; (3) more efficiency in research reporting; and (4) opportunities for model implementation investigation. GRA

83 ECONOMICS AND COST ANALYSIS

Includes cost effectiveness studies.

N78-12900# DRC Inventory Research Office, Philadelphia, Pa.
BARE BONES: A METHOD FOR ESTIMATING PROVISIONING BUDGET REQUIREMENTS IN THE OUTYEARS Final Report
Donald A. Orr Jul. 1977 48 p refs
(AD-A044508; IRO-242) Avail: NTIS HC A03/MF A01 CSCL 05/1

Different methodologies and procedures are currently used by Project Managers/Commodity Commands in the Army to estimate initial provisioning funding requirements early in the development cycle of a system/end item. These estimates are to project support costs 1-5 years hence, but there has been a lack of quality, uniform methodology, and defensible rationale in the estimates. This paper develops a prototype methodology that reflects, early on, the quantities and costs that would be determined ultimately using the Standard Initial Provisioning model (SIP) just prior to the deployment of the end item in the budget execution year. An important pillar of the new procedure is a cumulative cost curve, generated from the provisioning costs of a small percentage of the total components, from which extrapolations are made of the total provisioning costs for the system. Selection of critical components is made by ranking parts by replacements per 100 end items x component unit price. GRA

84 LAW AND POLITICAL SCIENCE

Includes space law; international law; international cooperation; and patent policy.

No abstracts in this category.

85 URBAN TECHNOLOGY AND TRANSPORTATION

Includes applications of space technology to urban problems; technology transfer; technology assessment; and surface and mass transportation.

For related information see *03 Air Transportation and Safety, 16 Space Transportation,* and *44 Energy Production and Conversion.*

N78-12901 Tennessee Univ., Knoxville.
AEROBIC STABILIZATION OF WASTE ACTIVATED SLUDGE Ph.D. Thesis
Philip Scott Pagoria 1977 436 p
Avail: Univ. Microfilms Order No. 77-16593

Aerobic digestion of an industrial waste activated sludge was investigated using a continuous-feed with solids-liquid separation and solids recycle flow scheme. A kinetic model to predict process performance was established which considered solids retention time and a coefficient representing the rate of sludge stabilization. Validity of this model was then tested using experimental data from pilot-scale aerobic digestion tests. Validation of the model was based on three different quantitative measures of viable sludge microbial mass: dissolved oxygen uptake rate, adenosine 5'-triphosphate concentration, and estimated biodegradable volatile suspended solids. Dissert. Abstr.

N78-12902# Battelle Columbus Labs., Ohio.
FORECASTING SCIENCE AND INDUSTRY Final Report
A. N. Christakis, S. Globe, and K. Kawamura 6 May 1977 189 p
(Grant NSF PRM-77-08336)
(PB-269190/5) Avail: NTIS HC A09/MF A01 CSCL 05A

A project was undertaken to forecast the future of science and industry and the relationship between the two, for the decade 1980 to 1990. The project had both a methodological purpose and a substantive objective. Methodologically, its purpose was to devise an approach to make such forecasts, and to render them credible and plausible through a dialogue among experts. For the substantive objective, the following five industries were selected for the forecasts: (1) chemicals; (2)electronics; (3) health care delivery; (4) metals and transportation equipment; and (5) two sciences were chosen to be forecast, chemistry and materials science. GRA

N78-12903# Transportation Systems Center, Cambridge, Mass.
SERVICE AND METHODS DEMONSTRATION PROGRAM Final Report, Jul. 1975 - Oct. 1976
Donald Kendall Apr. 1977 566 p
(PB-270673/7; DOT-TSC-UMTA-77-20; UMTA-MA-06-0049-77-2) Avail: NTIS HC A25/MF A01 CSCL 13B

Urban transportation systems designed to decrease transit travel time, increase transit reliability, increase transit coverage, increase transit vehicle productivity, and improve the mobility of transit dependents are evaluated. Independent activities carried out in support of the demonstrations are described, such as the development of evaluation guidelines and improved methodologies for demonstration evaluation, analytical studies in support of the development of experimental demonstrations, studies of independent local innovations, and case studies of transit operations in small communities. GRA

N78-12904# Utah Water Research Lab., Logan.
OPTIMAL WATER PLANNING SERIES. RURAL DOMESTIC WATER SYSTEM PEAK FLOWS AND DESIGN INNOVATIONS
Trevor C. Hughes, Yukio Kono, and Ronald Canfield Jan. 1977 54 p
(Contract DI-14-34-0001-7094)
(PB-270671/1; PRJER030-3; W77-10176; OWRT-A-030-UTAH (1)) Avail: NTIS HC A04/MF A01 CSCL 13B

Peak instantaneous flow rates in a Utah rural system were measured continuously during two summers on three dead-end lines serving various numbers of customers. The second summer included measurement of flows to customers whose maximum flow rate was limited by a simple orifice placed in each meter. Actual peak demands were lower than those required for design purposes. Where extremely small mains are required by the economics of low density situations, peak demands can be cut significantly by flow restricting devices at each meter. GRA

N78-12905# Futures Group, Gastonbury, Conn.
STUDY OF THE FUTURE: AN AGENDA FOR RESEARCH
W. I. Boucher Jul. 1977 325 p
(Grant NSF GI-37178)
(PB-271303/0; NSF/RA-770036) Avail: NTIS HC A14/MF A01 CSCL 05A

Forecasting methodology, the validity of forecasting systems, and the nature of unforeseen developments are discussed as well as attitudes toward forecasting in political science and sociology, technological forecasting, forecasting in economics, forecasting and its impact on policymaking, problems in futures research, and forecasting when the future is known, such as in the Soviet Union. The futures field is explored including its functions, forms and critical issues, communications in futures research, and the monitoring of the future. An agenda for futures research and a statement of research needs are presented. GRA

N78-12906# Applied Physics Lab., Johns Hopkins Univ., Laurel, Md.
POINT-FOLLOWER AUTOMATIC VEHICLE CONTROL: A GENERIC ANALYSIS Final Report
S. J. Brown, Jr. May 1977 161 p refs
(Contract DOT-UT-30010)
(PB-270354/4; UMTA-MD-06-0022-77-1) Avail: NTIS HC A08/MF A01 CSCL 13F

Generic characteristics of the point-follower approach to vehicle control for automated guideway transit systems were

examined. Under this system, vehicles are constrained to follow electronic signals that move along a guideway with predetermined speeds and spacings. A kinematic analysis was made of point-follower control during speed transitions and point transfer maneuvers generally required to resolve merge conflicts. A dynamic analysis was made, formulated as a problem in classic control theory. The traffic merging problem was addressed by the development of quasi-synchronous control algorithms for resolution of merge conflicts at network intersections of various geometries. GRA

N78-12907# JHK and Associates, Alexandria, Va.
PRIORITY TREATMENT FOR HIGH OCCUPANCY VEHICLES: PROJECT STATUS REPORT Interim Report, May 1976 - Mar. 1977
M. J. Rothenberg Mar. 1977 41 p
(Contract DOT-FH-11-8242)
(PB-270529/1; FHWA-RD-77-56) Avail: NTIS
HC A03/MF A01 CSCL 13B

The current status of 14 preferential treatment projects for buses and carpools in the United States is reviewed. The range of projects covered include bus and carpool lanes physically separated from the flow of other traffic, contra-flow lanes, exclusive median withflow lanes, bypasses of metered freeway ramps, and toll reductions for carpools. Key historical events in the development of each project are cited and observations are made on the effectiveness of each. GRA

N78-12908# Hebrew Univ., Jerusalem (Israel). Environmental Health Lab.
DETECTION AND INACTIVATION OF ENTERIC VIRUSES IN WASTEWATER Final Report, Oct. 1969 - Jan. 1975
Hillel I. Shuval and Eliyahu Katzenelson May 1977 304 p refs
(Grant EPA-S-800990)
(PB-270210/8; EPA-600/2-77-095) Avail: NTIS
HC A14/MF A01 CSCL 13B

The development and evaluation of methods for concentrating and assaying low levels of viruses in large volumes of water were investigated. Studies on the use of ozone in inactivating viruses in water and wastewater were also reported. Of the eight virus concentration methods evaluated, filtration with cellulose nitrate membranes, aluminum hydroxide and PE-60 proved most promising. The feasibility of using hollow fiber membranes was demonstrated and rapid method capable of detecting viruses in water in less than 24 hours using fluorescent antibodies was developed. GRA

N78-12909# Stanford Research Inst., Menlo Park, Calif.
TRANSPORTATION IN AMERICA'S FUTURE: POTENTIALS FOR THE NEXT HALF CENTURY. PART 2. TRANSPORTATION FORECASTS Final Report
David Curry, Richard Carlson, Clark Henderson, Thomas Mandel, and Arnold Mitchell Jun. 1977 343 p refs
(Contract DOT-OS-60160; SRI Proj. 5040)
(PB-270468/2; DOT/TPI/20-77/21-2-Pt-2) Avail: NTIS
HC A15/MF A01 CSCL 13B

Contents: transportation demand and energy estimates; transportation trends and issues under three futures for 1995; prospects for 2025 (air, avionics, shipping, pipelines and tunnels, railroads, intercity buses, highways and streets, trucking, automobiles, urban transit and rail, paratransit, pedestrian aids and bikeways, elderly and handicapped services); electric and hybrid automobiles; innovative urban systems; automated highway system; a generic approach to advanced freight systems; tracked levitated vehicles, improved passenger trains and buses; the successful SST; transportation implications of future telecommunications technology; transportation problems and opportunities. GRA

N78-12910# Stanford Research Inst., Menlo Park, Calif.
TRANSPORTATION IN AMERICA'S FUTURE: POTENTIALS FOR THE NEXT HALF CENTURY. PART 1: SOCIETAL Final Report
David Curry, Richard Carlson, Clark Henderson, Thomas Mandel, and Arnold Mitchell Jun. 1977 131 p refs
(Contract DOT-OS-60160; SRI Proj. 5040)
(PB-270467/4; DOT/TPI/20-77/21-1-Pt-1) Avail: NTIS
HC A07/MF A01 CSCL 13B

Four potential socioeconomic futures for the United States and their implications for transportation through 2025 are presented. The futures (designated Success,Foul Weather, Disciplined Society, and Transformation) vary in economic performance, climate, institutional structure, and personal values. For each future a narrative account or scenario is given with separate analyses of the energy, demographic, economic, and urban implications of each scenario. Demand forecasts for most modes, technology forecasts for twelve transportation modes and seven specific systems or technologies, and analyses of six critical transportation problems are included. GRA

N78-12911#
THE FEASIBILITY OF UTILIZING SOLID WASTES FOR BUILDING MATERIALS. EXECUTIVE SUMMARY
Gilbert Jackson and Sylvia Nare Jun. 1977 96 p refs
(Contracts EPA-68-03-2460-1; EPA-68-03-2056)
(PB-271007/7; EPA-600/8-77-006) Avail: NTIS
HC A05/MF A01 CSCL 13B

The technological and commercial possibilities of using waste - derived composites as building materials were investigated. Various characteristics were considered desirable for the filler, the reinforcement and the matrix. The evaluative criteria and the rating system used are presented. Filler materials reviewed include fly ash, crushed glass, phosphate slimes, silicate waste, shredded refuse, waste plastic, wood bark, rice hulls, taconite, red mud, coal waste foundry ash and sawdust. Reinforcement materials studied include carbonized lignin, bagasse, wheat straw, bark, kenaf, bamboo, wood chips, cotton waste and glass roving. Sewage sludge, sawdust, rice hulls, plastic scrap and waste glass also received attention as reinforcements. GRA

N78-12912# Geological Survey, Indianapolis, Ind. Water Resources Div.
NATURE AND EXTENT OF GROUND-WATER-QUALITY CHANGES RESULTING FROM SOLID-WASTE DISPOSAL, MARION COUNTY, INDIANA Final Report, 1972 - 1975
Robert A. PettiJohn Jun. 1977 130 p refs Prepared in cooperation with Indianapolis Dept. of Public Works, Ind.
(PB-271019/2; USGS-WRD-WRI-77-047; USGS/WRI-77-40)
Avail: NTIS HC A07/MF A01 CSCL 13B

In five landfills in the Indianapolis area, movement of ground water is from the deep aquifers into the uppermost aquifer. In the other two landfills, movement of ground water is from the shallow aquifers to the deeper aquifers, so that leachate is transported into the deeper aquifers. In all the landfills, the predominant direction of ground-water movement is lateral. Ground-water mounding at shallow depths beneath two of the landfills has caused flow toward the edges of the two fills. Leachate at these fills is moving downward and outward and has affected water quality at shallow depths. Pumping near two other landfills has reversed the direction of regional ground water flow, allowing leachate to move toward the pumping wells. GRA

N78-12913# Department of Transportation, Washington, D. C. Office of the Secretary.
DEPARTMENT OF TRANSPORTATION BUDGET PROGRAM: ANALYSIS OF FISCAL YEAR 1978 DOT PROGRAM BY POLICY AND RD AND D MANAGEMENT OBJECTIVES. PROGRAM LEVELS FOR FISCAL YEARS 1976, 1977, 1978
Robert L. Paulin, Ira Dye, and Phillip H. Bolger 15 Jun. 1977 456 p refs
(PB-270676/0; DOT-OST-77-1) Avail: NTIS
HC A20/MF A01 CSCL 13B

A synopsis of the total budget program of the Department of Transportation (DOT) is summarized. The Research, Development and Demonstration (RD&D) and grant programs in terms of DOT policy and RD&D management objectives and other classification structures are summarized. Program information is presented for 1976 through 1978, including the 1976 to 1977 transition quarter. Communication between the various elements of DOT and other sectors of transportation, both public and private is emphasized, so as to obtain more benefits to the nation from the investments being made in transportation research. GRA

88 SPACE SCIENCES (GENERAL)

No abstracts in this category.

89 ASTRONOMY

Includes radio and gamma-ray astronomy; celestial mechanics; and astrometry.

N78-12914 Maryland Univ., College Park.
MODEL ATMOSPHERES FOR SIRIUS AND PROCYON Ph.D. Thesis
Leslie Allen Dreiling 1976 146 p
Avail: Univ. Microfilms Order No. 77-16368

Flux-constant model atmospheres were calculated for Sirius (A1 V) and Procyon (F5 IV-V). The computer program MARCS was used to compute the models which include both convection and line blanketing effects. Results for Sirius indicate that a model with effective temperature 10100 K, logarithm of the gravity equal to 4.30, and logarithm of the ratio of metal to hydrogen abundance relative to the sun of +0.50--abbreviated as (10100,4.30,+0.50)--shows excellent agreement with the observed energy distribution for the range lambda > 2600. The Procyon model (6560,4.00,0.00) exhibits good agreement for lambda > 3000. Other spectral details display similar good agreement for both models. Because of this good agreement the models derived give a more realistic representation of the atmospheres of these stars than has previously been obtained. Dissert. Abstr.

N78-12915 California Univ., Santa Cruz.
A COMPREHENSIVE STUDY OF TWELVE VERY RICH CLUSTERS OF GALAXIES Ph.D. Thesis
Alan Michael Dressler 1976 258 p
Avail: Univ. Microfilms Order No. 77-16794

A photographic photometry study was made of twelve very rich clusters of galaxies in order to compare many of the properties associated with clusters. The variations in the luminosity functions were compared to the random fluctuations expected with a universal function, as determined by a Monte Carlo generation technique. The concept of a universal luminosity function was found to be inconsistent with the observed fluctuations. Topics discussed include spatial distribution of clusters, mass/light ratios, galaxy alignment, population discrimination, and galactic evolution. Dissert. Abstr.

N78-12916 California Univ., Berkeley.
EVOLUTION OF CONTRACTING WHITE DWARFS AS PRESUPERNOVAE OF TYPE I Ph.D. Thesis
Yong Hak Kim 1976 208 p
Avail: Univ. Microfilms Order No. 77-15735

The possibility is considered through a numerical investigation that the progenitors of Type I supernovae are certain white dwarfs which become dynamically unstable due to e(-) captures by certain stable nuclei in their interiors. Detailed evolutionary sequences of white dwarf models were calculated with the Henyey method including composition changes which correspond to various e(-) captures. Dissert. Abstr.

N78-12917 California Univ., Santa Cruz.
SPECTROPHOTOMETRY OF SEYFERT 2 GALAXIES AND NARROW-LINE RADIO GALAXIES Ph.D. Thesis
Alan Thomas Koski 1976 151 p
Avail: Univ. Microfilms Order No. 77-16798

Spectrophotometric scans of twenty Seyfert 2 galaxies, three intermediate Seyfert galaxies, and five narrow-line radio galaxies are presented. The emission-line spectra are similar in all the galaxies. The strengths of lines of neutral atoms and singly-ionized ions are correlated with each other, while the strengths of lines of ions of higher ionization are separately correlated with each other. This suggests two distinct emitting regions: low ionization and high ionization. Two galaxies were observed to have different redshifts between lines from the low and high ionization regions. The velocity differences are less than the average emission-line full width at half maximum of 500-600 km/s in Seyfert 2 galaxies and narrow-line radio galaxies. The broad components of the intermediate Seyfert galaxies have velocity widths comparable with those of broad-line radio galaxies. Dissert. Abstr.

N78-12918 California Univ., Santa Cruz.
THE PROPERTIES OF THE RR LYRAE VARIABLES Ph.D. Thesis
Lee Hunt McDonald 1977 179 p
Avail: Univ. Microfilms Order No. 77-17274

Intrinsic colors of the RR Lyrae variables (Bailey type a) were derived using hydrogen line strengths. Effects of metal abundance on the relationship between intrinsic color and hydrogen line strength were determined from a grid of model atmospheres. Temperatures were also derived from the colors, using the model results. Photometric measurements were made to derive radii and absolute magnitudes by the Baade-Wesselink method. With these data, and light curves found in the literature, absolute magnitudes for 47 RR Lyrae stars were derived. The radial velocity curves of RR (a) variables are identical within the errors, irrespective of period or metal abundance. Thus it is not necessary to determine a radial velocity curve for each star in order to use the Baade-Wesselink method. Dissert. Abstr.

N78-12919 California Univ., Berkeley.
AN INFRARED UPCONVERSION DETECTOR FOR ASTRONOMY Ph.D. Thesis
Howard Alan Smith 1976 95 p
Avail: Univ. Microfilms Order No. 77-15861

An infrared upconversion detector/spectrometer, designed to observe astronomical sources, was built and successfully operated on a telescope. The system's conversion efficiency and phase-matching parameters agreed with theory, but its noise was substantially larger than expected. A new nonlinear process appears to be responsible. The noise intensity from this process depends on crystal properties; it limits the NEP of the present detector/spectrometer to approximately 10 to the minus 13th power watts/Hz/1/2 (at 3.4 micron). The observations did not produce any significant astrophysical information. The residual noise was about ten times stronger than upconverted infrared crystal radiation; otherwise radiation from the two processes was almost indistinguishable. A theory for the residual noise effect is presented. Dissert. Abstr.

90 ASTROPHYSICS

Includes cosmology; and interstellar and interplanetary gases and dust.

N78-12920 California Univ., Berkeley.
DISCOVERY OF INTERSTELLAR AMMONIA AND ITS USE AS A PROBE OF INTERSTELLAR CLOUDS Ph.D. Thesis
Albert Chi-Tong Cheung 1976 58 p
Avail: Univ. Microfilms Order No. 77-15634

A search for the ammonia molecule was conducted and the molecule was discovered in the direction of SGR A and subsequently also identified in a number of interstellar clouds by its inversion spectra. NH3 is widely distributed in interstellar space, and provides a good probe of the kinematics and structure of clouds. Galactic NH3 sources fall into three types, differing most obviously in velocity widths: galactic center sources, sources associated with HII regions, and dark dust clouds. Dissert. Abstr.

N78-12921 California Univ., Berkeley.
MASER AMPLIFIERS AND THEIR USE IN OBSERVATIONS OF AMMONIA IN DARK CLOUDS Ph.D. Thesis
Michael Fan Ming Chui 1976 172 p
Avail: Univ. Microfilms Order No. 77-15639

Single crystal pink ruby is the active material in traveling wave masers which were developed and interfaced with spectral line receivers to study the transitions, occurrences, and emission spectra of ammonia in dark instellar clouds. The ammonia transitions examined arise from the (1,1) and (2,2) metastable

inversion levels. The observed hyperfine structure intensities of the (1,1) transition are used to determine line opacities, and the (2,2) observations lead to derived rotation temperatures which closely reflect kinetic temperatures. Column densities and other parameters are compared with those of formaldehyde and carbon monoxide. Ammonia is generally found to be present in the same regions of space as H2CO and CO. The NH3 emission does not exhibit any correlation with the presence of near infrared sources, and possible reasons for this are discussed.
Dissert. Abstr.

N78-12922 California Univ., Berkeley.
Ne II 12.8 MICRONS EMISSION FROM THE GALACTIC CENTER AND COMPACT H II REGIONS Ph.D. Thesis
Eric Robert Wollman 1976 98 p
Avail: Univ. Microfilms Order No. 77-15915

A tandem scanning Fabry-Perot interferometer and a 3M telescope were used to observe the Ne II fine-structure emission line from the galactic center and several compact H II regions. The compact H II region G333.6-0.2 was studied by comparing the predictions of a model with the observed thermal radio continuum, Ne II (12.8 micron) emission, S III (18.7 micron) emission and infrared continuum. The central brightness of Ne II emission from three other compact H II regions (G268.0-1.1, G291.3-0.7 and G298.2-0.3) was measured. Doppler velocities of the Ne II emission from the galactic center range from about +200 km/s to -350 km/s with respect to the local standard of rest.
Dissert. Abstr.

N78-12923 California Univ., Berkeley.
IRIS: AN EXPERIMENT TO MEASURE THE ISOTOPIC COMPOSITION OF IRON IN THE GALACTIC COSMIC RADIATION Ph.D. Thesis
Steven Paul Ahlen 1976 242 p
Avail: Univ. Microfilms Order No. 77-15585

Two plastic scintillation counters, one Cerenkov counter, and a stack of Lexan polycarbonate sheets to measure particle range were combined to achieve the resolution required to measure the isotopic composition of iron group nuclei in the primary cosmic rays. A quantitative understanding of the response of a wave shifted Cerenov radiator was obtained for primary Cerenkov radiation, secondary radiation, and scintillation. A respectable fit of the scintillation response as a function of charge and velocity to an existing model was achieved. The range peak of a heavy ion beam was shown to be not seriously degraded by a large nuclear interaction background. The construction, evaluation and charge and mass resolution capabilities of the detector are described.
Dissert. Abstr.

N78-12924 Maryland Univ., College Park.
THE ORBITS OF THE GALILEAN SATELLITES OF JUPITER Ph.D. Thesis
Bryan Conrad Brown 1976 209 p
Avail: Univ. Microfilms Order No. 77-16357

The long period behavior of the orbits of the Galilean satellites computer programs were used to perform all the algebraic manipulations and series expansions necessary to describe the mutual interactions among the satellites. Analytical solutions and numerical integrations indicate that at least three different kinds of mean motion must be distinguished: (1) the observed mean motion; (2) the 'mean' mean motion, as defined in standard planetary theory, which appears as the constant term in the differential equation for the mean longitude; and (3) the osculating mean motion, related to the semi-major axis via Kepler's Third Law.
Dissert. Abstr.

N78-12925*# National Aeronautics and Space Administration, Washington, D. C.
THE SOVIET-AMERICAN CONFERENCE ON COSMOCHEMISTRY OF THE MOON AND PLANETS, PART 1
John H. Pomeroy, ed. and Norman J. Hubbard, ed. 1977 503 p refs Conf. held at Moscow, 4-8 Jun. 1974
(NASA-SP-370-Pt-1; LC-75-600013) Avail: NTIS MF A01; SOD HC CSCL 03B

The basic goal of the conference was consideration of the origin of the planets of the solar system, based on the physical and chemical data obtained by study of the material of the moon and planets. Papers at the conference were presented in the following sessions: (1) Differentiation of the material of the moon and planets; (2) The thermal history of the moon; (3) Lunar gravitation and magnetism; (4) Chronology of the moon, planets, and meteorites; (5) The role of exogenic factors in the formation of the lunar surface; (6) Cosmochemical hypotheses about the origin and evolution of the moon and planets; and (7) New data about the planets Mercury, Venus, Mars, and Jupiter. For individual titles, see N78-12926 through N78-12957.

N78-12926*# Academy of Sciences (USSR), Moscow. V. I. Vernadskiy Inst. of Geochemistry and Analytical Chemistry.
DIFFERENTIATION OF THE MATTER OF THE MOON
A. P. Vinogradov *In* NASA, Washington The Soviet-Am. Conf. on Cosmochem. of the Moon and Planets, pt. 1 1977 p 5-33 refs (For availability see N78-12925 03-90)
Avail: NTIS MF A01; SOD HC CSCL 03B

The following facts were uncovered in comparing the basaltic surface rocks of the moon with terrestrial tholeiitic basalts and ordinary chondrites: (1) there is an excess of the so-called refractory chemical elements, including the group of truly refractory elements, the rare earths, U, and Th, in comparison with their content in primitive terrestrial basalts and chondrites; (2) the so-called siderophilic elements have lower contents in the lunar surface rocks than in terrestrial rocks; (3) the low alkali content (Na, K, Rb) in lunar rocks is established; (4) there is a low content of H2O and the ordinary gases CO2, halides, etc.; (5) the low content of metals with high vapor pressure, (In, Tl, etc.) has been established. It is proposed that U and Th were carried from the internal areas to the peripheral rocks of the moon during magmatic activity, i.e., up to 3 billion years ago. This redistribution of U and Th lead to their concentration in surface layers of the moon, and the heat which they generated was lost into surrounding space. The conclusion is then reached that in order to understand processes on the moon, the chondritic model cannot be used.
Author

N78-12927*# Center for Astrophysics, Cambridge, Mass.
A SURVEY OF LUNAR ROCK TYPES AND COMPARISON OF THE CRUSTS OF EARTH AND MOON
John A. Wood *In* NASA, Washington The Soviet-Am. Conf. on Cosmochem. of the Moon and Planets, pt. 1 1977 p 35-53 refs (For availability see N78-12925 03-90)
Avail: NTIS MF A01; SOD HC CSCL 03B

The principal known types of lunar rocks are briefly reviewed, and their chemical relationships discussed. In the suite of low-KREEP highland rocks, Fe/(Fe + Mg) in the normative mafic minerals increases and the albite content of normative plagioclase decreases as the total amount of normative plagioclase increases, the opposite of the trend predicted by the Bowen reaction principle. The distribution of compositions of rocks from terrestrial layered mafic intrusives is substantially different: here the analyses fall in several discrete clusters (anorthositic rocks, norites, granophyres and ferrogabbros, ultramafics), and the chemical trends noted above are not reproduced. It is suggested that the observed trends in lunar highland rocks could be produced by crystal fractionation in a deep global surface magma system if (1) plagioclase tended to float, upon crystallization, and (2) the magma was kept agitated and well mixed (probably by thermal convection) until crystallization was far advanced and relatively little residual liquid was left. After the crustal system solidified, but before extensive cooling had developed a thick, strong lithosphere, mantle convection was able to draw portions of the lunar anorthositic crust down into the mantle.
Author

N78-12928*# Lunar Science Inst., Houston, Tex.
GEOCHEMICAL ZONING AND EARLY DIFFERENTIATION IN THE MOON
S. R. Taylor and P. Jakes *In* NASA, Washington The Soviet-Am. Conf. on Cosmochem. of the Moon and Planets, pt. 1 1977 p 55-61 refs (For availability see N78-12925 03-90)
(Contract NSR-09-051-001)
(Contrib-229) Avail: NTIS MF A01; SOD HC CSCL 03B

The volatile elements (e.g., Rb, Pb, Tl, Bi, Cs) seem to have been depleted at the time of lunar accretion. Accordingly, it may be assumed that the moon initially accreted from refractory material. The good correlation between volatile/involatile element ratios (e.g., Cs/U, K/La, K/Zr) in both highland and maria samples means that element distribution in lunar crustal rocks is not

governed by volatility differences. This and other evidence encourages the view that the moon was accreted homogeneously. A consequence of homogeneous accretion theories is that very efficient large-scale element fractionation is required to account both for the high near-surface concentrations of refractory elements (e.g., Th, U, REE, Zr, Ba, etc.) and for the Ca-Al-rich crust. Author

N78-12929*# National Aeronautics and Space Administration, Washington, D. C.

EVOLUTION OF THE MOON: THE 1974 MODEL

Harrison H. Schmitt *In its* The Soviet-Am. Conf. on Cosmochem. of the Moon and Planets, pt. 1 1977 p 63-80 refs (For availability see N78-12925 03-90)

Avail: NTIS MF A01; SOD HC CSCL 03B

The interpretive evolution of the moon can be divided now into seven major stages beginning sometime near the end of the formation of the solar system. These stages and their approximate durations in time are as follows: (1) The Beginning: 4.6 billion years ago, (2) The Melted Shell: 4.6 to 4.4 billion years ago, (3) The Cratered Highlands: 4.4 to 4.1 billion years ago, (4) The Large Basins: 4.1 to 3.9 billion years ago, (5) The Light-colored Plains: 3.9 to 3.8 billion years ago, (6) The Basaltic Maria: 3.8 to 3.0(?) billion years ago, and (7) The Quiet Crust: 3.0(?) billion years ago to the present. The contributions of the Apollo and Luna exploration toward the study of those stages of evolution are reviewed. Author

N78-12930*# California Inst. of Tech., Pasadena. Div. of Geological and Planetary Sciences.

PETROGENESIS OF LUNAR ROCKS: Rb-Sr CONSTRAINTS AND LACK OF H2O

Arden L. Albee and Alexander J. Gancarz *In* NASA, Washington The Soviet-Am. Conf. on Cosmochem. of the Moon and Planets, pt. 1 1977 p 81-90 refs (For availability see N78-12925 03-90)

(Grants NGL-05-002-188; NGL-05-002-338)

(Contrib-2474) Avail: NTIS MF A01; SOD HC CSCL 03B

Rb and Sr isotopic data and other chemical data indicate major lunar differentiation at about 4.6 AE (AE = 10 to the 9th power years) and very limited subsequent differentiation. The constraints of limited differentiation after 4.6 AE and the apparent lack of H2O on the moon, when applied to the derivation and petrogenesis of lunar samples, suggest the following: (1) soil samples, breccias, metaclastic rocks, and feldspathic basalts represent mixtures of repeatedly modified clastic material, which was ultimately derived from materials formed during the 4.6 AE differentiation; and (2) mare basalts crystallized from melts which formed by partial melting, and which developed without equilibrium between the melt and crystalline residuum. Author

N78-12931*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

LUNAR HIGHLAND ROCK TYPES: THEIR IMPLICATIONS FOR IMPACT-INDUCED FRACTIONATION

W. C. Phinney, J. L. Warner, and C. H. Simonds (Lunar Science Inst.) *In its* The Soviet-Am. Conf. on Cosmochem. of the Moon and Planets, pt. 1 1977 p 91-126 refs (For availability see N78-12925 03-90)

(Contract NSR-09-051-001)

(Contrib-230) Avail: NTIS MF A01; SOD HC CSCL 03B

Lunar rocks may be classified into three major groups: (1) coarse-grained igneous rocks, (2) fine-grained igneous rocks, and (3) breccias. Group 1 is interpreted as primitive lunar crustal rocks that display various degrees of crushing and/or annealing. Group 2 is interpreted as volcanic rocks. Group 3 is interpreted as resulting from impacts on the lunar surface and is subdivided on the basis of matrix textures into fragmental breccias, crystalline breccias that have been annealed, and crystalline breccias with igneous matrices. A synthesis of the data concerning lunar highlands polymict breccias compels the prediction that the breccias should have homogeneous matrices from rock to rock within regions of the highlands of limited size where impact mixing has been efficient and extensive. But the returned breccias, even from one landing site, display a wide range in composition. This incompatibility between prediction and observation is a paradox that may be resolved by a process that acts after impact mixing to cause a differentiation of the breccia compositions. Partial melting of the local average crustal composition (as modeled by the average soil composition for each site) and separation of melt and residue in ejecta and/or fall-back blankets are compatible with the reviewed data and may resolve the paradox. Author

N78-12932*# Harvard Univ., Cambridge, Mass. Center for Earth and Planetary Physics.

LUNAR IGNEOUS ROCKS AND THE NATURE OF THE LUNAR INTERIOR

James Fred Hays and David Walker *In* NASA, Washington The Soviet-Am. Conf. on Cosmochem. of the Moon and Planets, pt. 1 1977 p 127-135 refs (For availability see N78-12925 03-90)

(Grant NGL-22-007-247)

Avail: NTIS MF A01; SOD HC CSCL 03B

Lunar igneous rocks, properly interpreted, can give useful information about mineral assemblages and mineral chemistry as a function of depth in the lunar interior. Though intensely brecciated, terra rocks reveal, in their chemistry, evidence for a magmatic history. Partial melting of feldspathic lunar crustal material occurred in the interval 4.6 to 3.9 Gy. Melting of ilmenite-bearing cumulates at depths near 100 km produced parent magmas for Apollo 11 and 17 titaniferous mare basalts in the interval 3.8 to 3.6 Gy. Melting of ilmenite-free olivine pyroxenites (also cumulates?) at depths greater than 200 km produced low-titanium mare basalts in the interval 3.4 to 3.1 Gy. No younger igneous rocks have yet been recognized among the lunar samples and present-day melting seems to be limited to depths greater than 1000 km. Author

N78-12933*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

A CHEMICAL MODEL FOR LUNAR NON-MARE ROCKS

Norman J. Hubbard and J. Michael Rhodes (Lockheed Electronics Co., Houston, Tex.) *In its* The Soviet-Am. Conf. on Cosmochem. of the Moon and Planets, pt. 1 1977 p 137-151 refs (For availability see N78-12925 03-90)

Avail: NTIS MF A01; SOD HC CSCL 03B

Nearly all rocks returned from the moon are readily divided into three broad categories on the basis of their chemical compositions: (1) mare basalts, (2) non-mare rocks of basaltic composition (KREEP, VHA), and (3) anorthositic rocks. Only mare basalts may unambiguously be considered to have original igneous textures and are widely understood to have an igneous origin. Nearly all other lunar rocks have lost their original textures during metamorphic and impact processes. For these rocks one must work primarily with chemical data in order to recognize and define rock groups and their possible modes of origin. Non-mare rocks of basaltic composition have chemical compositions consistent with an origin by partial melting of the lunar interior. The simplest origin for rocks of anorthositic chemical composition is the crystallization and removal of ferromagnesian minerals. It is proposed that the rock groups of anorthositic and non-mare basaltic chemical composition could have been generated from a single series of original, but not necessarily primitive, lunar materials. Author

N78-12934*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

LUNAR ELEMENTAL ANALYSIS OBTAINED FROM THE APOLLO GAMMA-RAY AND X-RAY REMOTE SENSING EXPERIMENT

J. I. Trombka, J. R. Arnold (Calif. Univ., La Jolla), I. Adler (Maryland Univ., College Park), A. E. Metzger (JPL), and R. C. Reedy (LASL) *In its* The Soviet-Am. Conf. on Cosmochem. of the Moon and Planets, pt. 1 1977 p 153-182 refs (For availability see N78-12925 03-90)

Avail: NTIS MF A01; SOD HC CSCL 03B

Gamma-ray and X-ray spectrometers carried in the service modules of the Apollo 15 and Apollo 16 spacecraft were employed for compositional mapping of the lunar surface. The measurements involved the observation of the intensity and characteristic energy distribution of gamma rays and X-rays emitted from the lunar surface. A large-scale compositional map of over 10 percent of the lunar surface was obtained from an analysis of the observed spectra. The objective of the X-ray experiment was to measure the K spectral lines from Mg, Al, and Si. Spectra were obtained

and the data were reduced to Al/Si and Mg/Si intensity ratios and ultimately to chemical ratios. Analyses of the results have indicated (1) that the Al/Si ratios are highest in the lunar highlands and considerably lower in the maria, and (2) that the Mg/Si concentrations generally show the opposite relationship. The objective of the gamma-ray experiment was to measure the natural and cosmic-ray-induced activity emission spectrum. At this time, the elemental abundances for Th, U, K, Fe, Ti, Si, and O have been determined over a number of major lunar regions. Regions of relatively high natural radioactivity were found in the Mare Imbrium and Oceanus Procellarum regions. Author

N78-12935*# New Mexico Univ., Albuquerque. Dept. of Geology.

COMPARISON OF LUNAR ROCKS AND METEORITES: IMPLICATIONS TO HISTORIES OF THE MOON AND PARENT METEORITE BODIES

Martin Prinz, R. V. Fodor, and Klaus Keil *In* NASA, Washington The Soviet-Am. Conf. on Cosmochem. of the Moon and Planets, pt. 1 1977 p 183-199 refs (For availability see N78-12925 03-90)

(Grants NGL-32-004-063; NGL-32-004-064)

Avail: NTIS MF A01; SOD HC CSCL 03B

There are many similarities between lunar samples and stone meteorites. Lunar samples, especially from the highlands, indicate that they have been affected by complex and repeated impact processes. Similar complex and repeated impact processes have also been operative on the achondritic and chondritic meteorites. Similarities between lunar and meteoritic rocks are discussed as follows: (1) Monomict and polymict breccias occur in lunar rocks, as well as in achondritic and chondritic meteorites, having resulted from complex and repeated impact processes; (2) Chondrules are present in lunar meteorites, as well as in a few achondritic and most chondritic meteorites. They apparently crystallized spontaneously from molten highly supercooled droplets which may have formed from impact melts or, perhaps, volcanic processes (as well as from the solar nebula, in the case of meteoritic chondrites); (3) Lithic fragments vary from little modified (relative to the apparent original texture) to partly or completely melted and recrystallized lithic fragments. Their detailed study allows conclusions to be drawn about their parent rock types and their origin, thereby gaining insight into preimpact histories of lunar and meteoritic breccias. There is evidence that cumulate rocks were involved in the early history of both moon and parent meteorite bodies. Author

N78-12936*# Academy of Sciences (USSR), Moscow. V. I. Vernadskiy Inst. of Geochemistry and Analytical Chemistry.

RADIOACTIVITY OF THE MOON, PLANETS, AND METEORITES

Yu. A. Surkou and G. A. Fedoseyev *In* NASA, Washington The Soviet-Am. Conf. on Cosmochem. of the Moon and Planets, pt. 1 1977 p 201-218 refs (For availability see N78-12925 03-90)

Avail: NTIS MF A01; SOD HC CSCL 03B

Analytical data is summarized for the content of natural radioactive elements in meteorites, eruptive terrestrial rocks, and also in lunar samples returned by Apollo missions and the Luna series of automatic stations. The K-U systematics of samples analyzed in the laboratory are combined with data for orbital gamma-ray measurements for Mars (Mars 5) and with the results of direct gamma-ray measurements of the surface of Venus by the Venera 8 lander. Using information about the radioactivity of solar system bodies and evaluations of the content of K, U, and Th in the terrestrial planets, we examine certain aspects of the evolution of material in the protoplanetary gas-dust cloud and then in the planets of the solar system. Author

N78-12937*# Academy of Sciences (USSR), Moscow. Committee on Meteorites.

THE EFFECT OF TEMPERATURE AND PRESSURE ON THE DISTRIBUTION OF IRON GROUP ELEMENTS BETWEEN METAL AND OLIVINE PHASES IN THE PROCESS OF DIFFERENTIATION OF PROTOPLANETARY MATERIAL

A. P. Vinogradov, N. P. Ilyin, and L. N. Kolomeytsava *In* NASA, Washington The Soviet-Am. Conf. on Cosmochem. of the Moon and Planets, pt. 1 1977 p 219-229 refs (For availability see N78-12925 03-90)

Avail: NTIS MF A01; SOD HC CSCL 03B

The distribution patterns of Ni, Co, Mn, and Cr were studied in olivines of various origins: from meteorites (chondrites, achondrites, pallasites), which are likely analogs of the protoplanetary material, to peridotite inclusions in kimberlite pipes, which are analogs of mantle material. According to X-ray microanalysis data, nickel is concentrated in peridotite olivines, while manganese is concentrated in meteoritic olivines. The maximum chromium content was found in ureilites, which were formed under reducing conditions. Experiments at pressures of 20 to 70 kbar and temperatures of 1100 to 2000 C have shown that in a mixture of olivine and Ni metal or NiO, nickel enters the silicate phase, displacing Fe into the metallic phase. Equilibrium temperatures were estimated from the Fe, Ni distribution coefficients between the metal and olivine: 1500 K for pallasites, 1600 K for olivine-bronzite H6 chondrites, 1200 K for olivine-hypersthene L6, 900 K for LL6, and 1900 K for ureilites (at P = 1 atm). The equilibrium conditions of peridotites are close to T = 1800 K and P over 100 kbar. It is concluded that there is a sharp difference between the conditions of differentiation of the protoplanetary material at the time meteorites were formed and the conditions of differentiation of the planets into concentric layers. Author

N78-12938*# Academy of Sciences (USSR), Moscow. V. I. Vernadskiy Inst. of Geochemistry and Analytical Chemistry.

THE CHEMICAL COMPOSITION OF THE CORES OF THE TERRESTRIAL PLANETS AND THE MOON

O. L. Kuskov and N. I. Khitarov *In* NASA, Washington The Soviet-Am. Conf. on Cosmochem. of the Moon and Planets, pt. 1 1977 p 231-242 refs (For availability see N78-12925 03-90)

Avail: NTIS MF A01; SOD HC CSCL 03B

Using models of the quasi-chemical theory of solutions, the activity coefficients of silicon are calculated in the melts Fe-Si, Ni-Si, and Fe-Ni-Si. The calculated free energies of solution of liquid nickel and silicon in liquid iron in the interval 0 to 1400 kbar and 1500 to 4000 K, shows that Fe-Ni-Si alloy is stable under the conditions of the outer core of the earth and the cores of the terrestrial planets. The oxidation-reduction conditions are studied, and the fugacity of oxygen in the mantles of the planets and at the core-mantle boundary are calculated. The mechanism of reduction of silicon is analyzed over a broad interval of p and T. The interaction between the matter of the core and mantle is studied, resulting in the extraction of silicon from the mantle and its solution in the material of the core. It is concluded that silicon can enter into the composition of the outer core of the earth and Venus, but probably does not enter into the composition of the cores of Mercury, Mars, and the moon, if in fact the latter possesses one. Author

N78-12939*# Academy of Sciences (USSR), Moscow. V. I. Vernadskiy Inst. of Geochemistry and Analytical Chemistry.

TO THE PROBLEM ABOUT THE ORIGIN OF LUNAR MARIA AND CONTINENTS (MOESSBAUER INVESTIGATIONS)

T. V. Malysheva *In* NASA, Washington The Soviet-Am. Conf. on Cosmochem. of the Moon and Planets, pt. 1 1977 p 243-251 refs (For availability see N78-12925 03-90)

Avail: NTIS MF A01; SOD HC CSCL 03B

A comparative study of Mossbauer spectra of regolith returned by the Luna 16 and Luna 20 spacecraft is presented. The Mossbauer spectra of the mare regolith differs significantly for all fractions from the spectra for the same fractions of continental regolith. The total quantity of iron is 1.85 times greater in the mare regolith. There is 2.4 times less olivine in the mare region than in the continental region. The pyroxene component of the mare regolith is less homogeneous in composition (contains more augite and glass) and is present in larger quantities. Ilmenite was found only in the mare regolith. In the continental region, the predominant titanium-containing phase is ulvospinel. The mare regolith contains more metallic iron, which is more finely dispersed and contains less nickel. Troilite is found in the maria region. Based on these differences, it is concluded that the formation of continental rocks occurred at an earlier stage of crystallization from the melt and at higher temperatures and higher partial pressures of oxygen. The mare basalts crystallized from a more reduced magma, apparently in a later process. Author

N78-12940*# Academy of Sciences (USSR), Moscow. Shternberg State Astronomical Inst.

THE SURFACE ABUNDANCE AND STRATIGRAPHY OF LUNAR ROCKS FROM DATA ABOUT THEIR ALBEDO

V. V. Shevchenko *In* NASA, Washington The Soviet-Am. Conf. on Cosmochem. of the Moon and Planets, pt. 1 1977 p 253-258 refs (For availability see N78-12925 03-90)

Avail: NTIS MF A01; SOD HC CSCL 03B

The data pf ground-based studies and surveys of the lunar surface by the Zond and Apollo spacecraft have been used to construct an albedo map covering 80 percent of the lunar sphere. Statistical analysis of the distribution of areas with various albedos shows several types of lunar surface. Comparison of albedo data for maria and continental areas with the results of geochemical orbital surveys allows the identification of the types of surface with known types of lunar rock. The aluminum/silicon and magnesium/silicon ratios as measured by the geochemical experiments on the Apollo 15 and Apollo 16 spacecraft were used as an indication of the chemical composition of the rock. The relationship of the relative aluminum content to the age of crystalline rocks allows a direct dependence to be constructed between the mean albedo of areas and the age of the rocks of which they are composed. Author

N78-12941*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

NEW DATA FOR THE LUNAR 20 CORE AND A SURVEY OF PUBLISHED CHEMICAL DATA

N. J. Hubbard, A. P. Vinogradov (Acad. of Sci., Moscow), G. I. Ramendik (Acad. of Sci., Moscow), and M. S. Chupakhin (Acad. of Sci., Moscow) *In its* The Soviet-Am. Conf. on Cosmochem. of the Moon and Planets, pt. 1 1977 p 259-262 refs (For availability see N78-12925 03-90)

Avail: NTIS MF A01; SOD HC CSCL 03B

Lunar core samples were analyzed using a spark source mass spectrometer. The analytical results for the four zones of the Lunar 20 core suggest that the core is nonuniform with depth. The higher concentrations of Ce, Sc, Sc, Ba, La, Co, Sr, and Zr in zone 2001 may be connected with the presence in this zone of a basaltic rock type seldom seen in the other zones. That is, about half of the basaltic fragments in the large size fractions in zone 2001 are of a specific porphyritic breccia-like type. Anorthositic fragments containing a notable amount of metallic iron are basically limited to zone 2004 and probably explain the lower concentrations of Ce, Rb, Ba, La, and perhaps Co in this zone. The high concentrations of Ag and Ce found previously are confirmed. Although Ag is at nearly the same concentration in all four zones of the core, Cd in the core is the result of local enrichment. In particular, in zone 2004 the concentration of Cd may be as high as 10 ppm in a sample size of 0.01 mg. Author

N78-12942*# Ceskoslovenska Akademie Ved, Prague. Geological Inst.

CHEMICAL COMPOSITION OF CRYSTALLINE ROCK FRAGMENTS FROM LUNA 16 AND LUNA 20 FINES

A. Cimbalnikova, M. Palivcova, J. Frana, and A. Mastalka *In* NASA, Washington The Soviet-Am. Conf. on Cosmochem. of the Moon and Planets, pt. 1 1977 p 263-275 refs (For availability see N78-12925 03-90)

Avail: NTIS MF A01; SOD HC CSCL 03B

The chemical composition (bulk, rare earth, and trace elements) of the Luna 16 mare regolith and luna 20 highland regolith is discussed. The rock samples considered are 14 basaltic rock fragments (Luna 16) and 13 rock fragments of the ANT suite (Luna 20). On the basis of bulk composition, two types of basaltic rocks have been differentiated and defined in the Luna 16 regolith: mare basalts (fundamental crystalline rocks of Mare Fecunditatis) and high-alumina basalts. The bulk analyses of rock fragments of the ANT suite also enabled distinction of two rock types: anorthositic norites and troctolites and/or spinel-troctolites (the most abundant crystalline rocks of the highland region, the landing site of luna 20), and anorthosites. The chemical compositions of Luna 16 and Luna 20 regolith samples are compared. Differences in the chemistry of the Luna 16 mare regolith and that of mare basalts are discussed. The chemical affinity between the Luna 20 highland regolith and (a) anorthositic norites and (b) troctolites and/or spinel-troctolites has been ascertained. Author

N78-12943*# Hungarian Academy of Sciences, Budapest. Central Inst. of Physical Research.

INVESTIGATION OF THE COMPOSITION OF THE LUNA 16 LUNAR SAMPLE

L. Bakos, M. Chayka, L. Cher, A. Cheke, N. N. Dogadkin, A. Elek, K. Kulchar, A. Nagy, D. L. Nagy, E. Szabo et al *In* NASA, Washington The Soviet-Am. Conf. on Cosmochem. of the Moon and Planets, pt. 1 1977 p 277-280 refs Prepared in cooperation with Acad. of Sci. (USSR), Moscow (For availability see N78-12925 03-90)

Avail: NTIS MF A01; SOD HC CSCL 03B

The concentrations of aluminum, manganese, sodium, chromium, iron, cobalt, and 12 rare earth elements were determined by neutron activation analysis using slow neutrons. Oxygen and silicon were determined using a fast neutron generator. Mossbauer spectroscopy was used to investigate iron compounds in Luna 16 regolith samples from the upper part of the core. Author

N78-12944*# Lamont-Doherty Geological Observatory, Palisades, N. Y.

IN-SITU MEASUREMENTS OF LUNAR HEAT FLOW

Marcus B. Langseth and Stephen J. Keihm *In* NASA, Washington The Soviet-Am. Conf. on Cosmochem. of the Moon and Planets, pt. 1 1977 p 283-293 refs (For availability see N78-12925 03-90)

(Contract NAS9-6037)

(Contrib-2141) Avail: NTIS MF A01; SOD HC CSCL 03B

During the Apollo program two successful heat flow measurements were made in situ on the lunar surface. At the Apollo 15 site a value of .0000031 W/sq cm was measured, and at the Apollo 17 site a value of .0000022 W/sq cm was determined. Both measurements have uncertainty limits of + or - 20 percent and have been corrected for perturbing topographic effects. The apparent difference between the observations may correlate with observed variations in the surface abundance of thorium. Comparison with earlier determinations of heat flow, using the microwave emission spectrum from the moon, gives support to the high gradients and heat flows observed in situ. Author

N78-12945*# Massachusetts Inst. of Tech., Cambridge. Dept. of Earth and Planetary Sciences.

THE EVOLUTION OF THE MOON AND THE TERRESTRIAL PLANETS

M. Nafi Toksoez and David H. Johnston *In* NASA, Washington The Soviet-Am. Conf. on Cosmochem. of the Moon and Planets, pt. 1 1977 p 295-327 refs (For availability see N78-12925 03-90)

(Contract NAS1-9703; Grants NGL-22-009-187; NsG-7081)

Avail: NTIS MF A01; SOD HC CSCL 03B

The thermal evolutions of the Moon, Mars, Venus, and Mercury were calculated theoretically starting from cosmochemical condensation models. An assortment of geological, geochemical, and geophysical data were used to constrain both the present day temperature and the thermal histories of the planets' interiors. Such data imply that the planets were heated during or shortly after formation and that all the terrestrial planets started their differentiations early in their history. Author

N78-12946*# Academy of Sciences (USSR), Moscow. O. Yu. Schmidt Inst. of Earth Physics.

HEAT FLOW AND THERMAL HISTORY OF THE MOON

Ye. A. Lyubimova *In* NASA, Washington The Soviet-Am. Conf. on Cosmochem. of the Moon and Planets, pt. 1 1977 p 329-346 refs (For availability see N78-12925 03-90)

Avail: NTIS HC A01; SOD HC CSCL 03B

An analysis was made of current heat flow data and thermal models of lunar evolution which satisfy the diverse information that has accumulated on internal processes. Author

N78-12947*# Scientific Research Inst. of Radio Physics, Gorky (USSR).

CALCULATIONS OF THE MOON'S THERMAL HISTORY AT DIFFERENT CONCENTRATIONS OF RADIOACTIVE ELEMENTS, TAKING INTO ACCOUNT DIFFERENTIATION ON MELTING

O. I. Ornatskaya, Ya. I. Alber, and I. L. Ryazantseva *In* NASA, Washington The Soviet-Am. Conf. on Cosmochem. of the Moon and Planets, pt. 1 1977 p 347-366 refs (For availability see N78-12925 03-90)
Avail: NTIS MF A01; SOD HC CSCL 03B

Calculations of the thermal history of the moon were done by solving the thermal conductivity equation for the case in which the heat sources are the long lived radioactive elements Th, U, and K-40. The concentrations of these elements were adjusted to give 4 variations of heat flow. Calculations indicated that the moon's interior was heated to melting during the first 0.7 to 2.3 x 10 to the 9th power years. The maximum fusion involved practically the entire moon to a distance from 15 to 45 km beneath the surface, and started 3.5 to 4.0 x 10 to the 9th power years ago, or 2.5 x 3.0 x 10 to the 9th power years ago and continued for 1 to 2 x 10 to the 9th power years. The moon today is cooling. The current thickness of the solid crust is from 150 to 200 km and the heat flow exceeds the stationary value 1.5 fold. Author

N78-12948*# Academy of Sciences (USSR), Moscow. O. Yu. Schmidt Inst. of Earth Physics.
RIDDLES ABOUT THE ORIGIN AND THERMAL HISTORY OF THE MOON
B. Yu. Levin and S. V. Mayeva *In* NASA, Washington The Soviet-Am. Conf. on Cosmochem. of the Moon and Planets, pt. 1 1977 p 367-385 refs (For availability see N78-12925 03-90)
Avail: NTIS MF A01; SOD HC CSCL 03B

Magmatic differentiation of the moon's interior, confirmed through calculations of thermal history, was studied. It appears that differentiation was a result of the moon's initial temperature whose origin remains unknown. In solving this problem, convective models of the moon were considered as well as a two layered differentiated model of the moon, operative over the past 3.5 billion years. The high content of long lived radioactive elements present was investigated in explaining the moon's current thermal properties. The controversy concerning the true nature of magmatic differentiation continues to be unsolved. Author

N78-12949*# Texas Univ., Galveston. Div. of Solid Earth and Planetary Geophysics.
RESULTS FROM THE APOLLO PASSIVE SEISMIC EXPERIMENT
Gary Latham, Yosio Nakamura, James Dorman, Frederick Duennebier, Maurice Ewing, and David Lammlein *In* NASA, Washington The Soviet-Am. Conf. on Cosmochem. of the Moon and Planets, pt. 1 1977 p 389-401 refs (For availability see N78-12925 03-90)
(Contract NAS9-13143)
(Contrib-44) Avail: NTIS MF A01; SOD HC CSCL 03B

Recent results from the Apollo Seismic Network suggest that primitive differentiation occurred in the outer shell of the moon to a depth of approximately 300 km and the central region of the moon is presently molten to a radius of between 200 and 300 km. If early melting to a depth of 300 to 400 km was a consequence of accretional energy, very short accretion times are required. It was shown that the best model for the zone of original differentiation is a crust 40 to 80 km thick, ranging in composition from anorthositic gabbro to gabbro, and overlying an ultramafic cumulate about 250 km thick. The best candidate for the molten core appears to be iron or iron sulphide. A new class of seismic signals recently were identified that may correspond to shallow moonquakes. These are rare, but much more energetic than the more numerous, deep moonquakes. Author

N78-12950*# Academy of Sciences (USSR), Moscow. O. Yu. Schmidt Inst. of Earth Physics.
LUNAR MASCONS
V. N. Zharkov and A. P. Trubitsyn *In* NASA, Washington The Soviet-Am. Conf. on Cosmochem. of the Moon and Planets, pt. 1 1977 p 403-405 (For availability see N78-12925 03-90)
Avail: NTIS MF A01; SOC HC CSCL 03B

Large positive anomalies have been discovered in the moon's gravitational field. The concept of mascons as the source of these anomalies was reviewed. Ideas set forth in the literature and related in some manner to mascons are summarized. Lunar structure and evolution are emphasized and it is concluded that more detailed studies of the moon by spacecraft are needed to solve remaining uncertainties. B.L.P.

N78-12951*# Brown Univ., Providence, R. I. Dept. of Geological Sciences.
SOME GEOLOGIC OBSERVATIONS CONCERNING LUNAR GEOPHYSICAL MODELS
James W. Head *In* NASA, Washington The Soviet-Am. Conf. on Cosmochem. of the Moon and Planets, pt. 1 1977 p 407-416 refs (For availability see N78-12925 03-90)
Avail: NTIS MF A01; SOD HC CSCL 03B

The distribution of lunar geologic units in space and time and their mode of origin were considered since they provided significant data which bear on a number of current problems in lunar geophysics. Observations and problems were discussed which deal with the characterization of the upper 25 km of the lunar crust, the tectonic style of the crust, the formation of mascons within major basins, analysis of lunar magnetic anomalies, and the history of the lunar crust. Author

N78-12952*# Toronto Univ. (Ontario). Dept. of Geology.
MAGNETIC AND DIELECTRIC PROPERTIES OF LUNAR SAMPLES
D. W. Strangway, G. W. Pearce, and G. R. Olhoeft *In* NASA, Washington The Soviet-Am. Conf. on Cosmochem. of the Moon and Planets, pt. 1 1977 p 417-431 refs Sponsored by Natl. Res. Council of Can. (For availability see N78-12925 03-90)
Avail: NTIS MF A01; SOD HC CSCL 03B

Dielectric properties of lunar soil and rock samples showed a systematic character when careful precautions were taken to ensure there was no moisture present during measurement. The dielectric constant (K) above 100,000 Hz was directly dependent on density according to the formula K = (1.93 + or - 0.17) to the rho power where rho is the density in g/cc. The dielectric loss tangent was only slightly dependent on density and had values less than 0.005 for typical soils and 0.005 to 0.03 for typical rocks. The loss tangent appeared to be directly related to the metallic ilmenite content. It was shown that magnetic properties of lunar samples can be used to study the distribution of metallic and ferrous iron which shows systematic variations from soil type to soil type. Other magnetic characteristics can be used to determine the distribution of grain sizes. Author

N78-12953*# Academy of Sciences (USSR), Moscow. Inst. of Terrestrial Magnetism, the Ionosphere and Radio Wave Propagation.
MAGNETIC FIELD IN LE MONNIER BAY ACCORDING TO DATA OF LUNOKHOD 2
Sh. Sh. Dolginov, Ye. G. Yeroshenko, L. N. Zhuzgov, V. A. Sharova, G. A. Vnuchkov, B. A. Okulessky, and A. T. Bazilevskiy *In* NASA, Washington The Soviet-Am. Conf. on Cosmochem. of the Moon and Planets, pt. 1 1977 p 433-441 refs (For availability see N78-12925 03-90)
Avail: NTIS MF A01; SOD HC CSCL 03B

Results of the first traverse measurement of the magnetic field on the surface of the moon are analyzed. The mean value of the magnetic field in the portion of Le Monnier Bay investigated is estimated at 20 to 30 gammas. An anomaly of the field was disclosed, which is confined to craters that exceed 50 meters in size. Author

N78-12954*# Academy of Sciences (USSR), Moscow. Inst. of Space Research.
DEEP ELECTROMAGNETIC SOUNDING OF THE MOON WITH LUNOKHOD 2 DATA
L. L. Vanyan, I. V. Yegorov, and E. B. Faynberg *In* NASA, Washington The Soviet-Am. Conf. on Cosmochem. of the Moon and Planets, pt. 1 1977 p 443-446 refs (For availability see N78-12925 03-90)
Avail: NTIS MF A01; SOD HC CSCL 03B

Results of electromagnetic sounding distinguished an outer high resistance shell about 200 km thick in the moon's structure. A preliminary petrological interpretation of the moon's layers indicated their origin as a consequence of differentiation of the initial peridotite material. Upon melting, 20% to 40% of the

material melts and is removed to form a high resistance basaltic shell underlain by a layer of spinal peridotites enriched in divalent iron oxides and having a reduced resistance. B.L.P.

N78-12956*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
LUNAR ELECTRICAL CONDUCTIVITY, PERMEABILITY AND TEMPERATURE FROM APOLLO MAGNETOMETER EXPERIMENTS
P. Dyal, C. W. Parkin (Santa Clara Univ.), and W. D. Daily (Brigham Young Univ.) *In its* The Soviet-Am. Conf. on Cosmochem. of the Moon and Planets, pt. 1 1977 p 447-491 refs (For availability see N78-12925 03-90)
Avail: NTIS MF A01; SOD HC CSCL 03B

Magnetometers were deployed at four Apollo sites on the moon to measure remanent and induced lunar magnetic fields. Measurements from this network of instruments were used to calculate the electrical conductivity, temperature, magnetic permeability, and iron abundance of the lunar interior. The measured lunar remanent fields range from 3 gammas minimum at the Apollo 15 site to 327 gammas maximum at the Apollo 16 site. Simultaneous magnetic field and solar plasma pressure measurements show that the remanent fields at the Apollo 12 and 16 sites interact with, and are compressed by, the solar wind. Remanent fields at Apollo 12 and Apollo 16 are increased 16 gammas and 32 gammas, respectively, by a solar plasma bulk pressure increase of 1.5 X 10 to the -7th power dynes/sq cm. Global lunar fields due to eddy currents, induced in the lunar interior by magnetic transients, were analyzed to calculate an electrical conductivity profile for the moon. From nightside magnetometer data in the solar wind it was found that deeper than 170 km into the moon the conductivity rises from .0003 mhos/m to .10 mhos/m at 100 km depth. Recent analysis of data obtained in the geomagnetic tail, in regions free of complicating plasma effects, yields results consistent with nightside values. Author

N78-12956*# Academy of Sciences (USSR), Moscow.
ON THE MECHANISM OF THE MAGNETIC DYNAMO OF THE PLANETS
Sh. Sh. Dolginov *In* NASA, Washington The Soviet-Am. Conf. on Cosmochem. of the Moon and Planets, pt. 1 1977 p 493-498 refs (For availability see N78-12925 03-90)
Avail: NTIS MF A02; SOD HC CSCL 03B

Results of testing the effectiveness of the theory of precessional dynamos in the generation of the magnetic fields of the planets are presented. It is shown that the magnetic state of Earth and of the planets Mars, Jupiter, and Venus can be satisfactorily described by the formula H(i) = H(3) V(i)/V(3) T(3)/T(i) omega(i)/omega(3) sin(alpha 1)/sin(alpha 2) where H, V, T, omega and alpha are the dipole fields, volumes of liquid cores, periods of rotation, rates of precession, and angles between precession vector and angular rotation, respectively, for the planets and earth. The v(i) corresponds to known models of the internal structure. It is shown that the magnetic state of Mercury satisfies this formula if the dynamic flattening of the planet f = .000057-.000083. Author

N78-12957*# Newcastle-upon-Tyne Univ. (England). Dept. of Geophysics and Planetary Physics.
THE INTENSITY OF THE ANCIENT LUNAR FIELD FROM MAGNETIC STUDIES ON LUNAR SAMPLES
A. Stephenson, D. W. Collinson, and S. K. Runchorn *In* NASA, Washington The Soviet-Am. Conf. on Cosmochem. of the Moon and Planets, pt. 1 1977 p 499-503 refs (For availability see N78-12925 03-90)
Avail: NTIS MF A01; SOD HC CSCL 03B

Palaeointensity determination on Apollo 11, 16, and 17 rocks have indicated that from 3.9 to 4.0 AE ago the strength of the surface lunar magnetic field was about 1.3 Oe, while there is evidence from younger rocks that a field of about one quarter of this value was present at a later time (3.6 AE). Author

N78-12958*# National Aeronautics and Space Administration, Washington, D. C.
THE SOVIET-AMERICAN CONFERENCE ON COSMOCHEMISTRY OF THE MOON AND PLANETS, PART 2
John H. Pomeroy, ed. and Norman J. Hubbard, ed. 1977 423 p refs Conf. held at Moscow, 4-8 Jun. 1974 (NASA-SP-370-Pt-2; LC-75-600013) Avail: NTIS MF A01; SOD HC CSCL 03B

The origin and evolution of the solar system is discussed based on ground and satellite observations. For individual titles, see N78-12959 through N78-12988.

N78-12959*# Geological Survey, Denver, Colo.
EARLY HISTORY OF THE MOON: IMPLICATIONS OF U-Th-Pb AND Rb-Sr SYSTEMATICS
Mitsuyobu Tatsumoto, Paul D. Numes, and Daniel M. Unruh *In* NASA, Washington The Soviet-Am. Conf. on Cosmochem. of the Moon and Planets, Pt. 2 1977 p 507-523 refs (For availability see N78-12958 03-90)
Avail: NTIS MF A01; SOD HC CSCL 03B

Anorthosite 60015 contains the lowest initial Sr-87/Sr-86 ratio yet reported for a lunar sample. The initial ratio is equal to that of the achondrite Angra dos Reis and slightly higher than the lowest measured Sr-87/Sr-86 ratio for an inclusion in the C3 carbonaceous chondrite Allende. The Pb-Pb ages of both Angra does Reis and Allende are 4.62 X 10 to the ninth power yr. Thus, the initial Sr/87/Sr-86 ratio found in lunar anorthosite 60015 strongly supports the hypothesis that the age of the Moon is about 4.65 b.y. The U-238/Pb-204 value estimated for the source of the excess lead in 'orange soil' 74220 is approximately 35 and lower than the values estimated for the sources of KREEP (600-1000), higk-K (300-600), and low-K (100-300) basalts. From these and other physical, chemical and petrographic results it was hypothesized that (1) the moon formed approximately 4.65 b.y. ago; (2) a global-scale gravitational differentiation occurred at the beginning of lunar history; and (3) the differentiation resulted in a radical chemical and mineralogical zoning in which the U-238/Pb-204 ratios increased toward the surface, with the exception of the low U-238/Pb-204 surficial anorthositic layer which 'floated' at the beginning of the differentiation relative to the denser pyroxene-rich material. Author

N78-12960*# Max-Planck-Institut fuer Kernphysik, Heidelberg (West Germany).
Ar-39Ar-40 DATING OF BASALTS AND ROCK BRECCIAS FROM APOLLO 17 AND THE MALVERN ACHONDRITE
T. Kirsten and P. Horn *In* NASA, Washington The Soviet-Am. Conf. on Cosmochem. of the Moon and Planets, Pt. 2 1977 p 525-540 refs (For availability see N78-12958 03-90)
Avail: NTIS MF A01; SOD HC CSCL 03B

The principles and the potential of the Ar-39/Ar-40 dating technique are illustrated by means of results obtained for 12 Apollo 17 rocks. Emphasis is given to methodical problems and the geological interpretation of lunar rock ages. Often it is ambigious to associate a given lunar breccia with a certain formation, or a formation with a basin. In addition, large-scale events on the Moon have not necessarily reset radiometric clocks completely. One rock fragment has a well-defined plateau age of 4.28 b.y., but the ages of two Apollo 17 breccias define an upper limit for the formation age of the Serenitatis basin at 4.05 b.y. Ages derived from five mare basalts indicate cessation of mare volcanism at Taurus-Littrow approximately 3.78 b.y. ago. Ca/Ar-37 exposure ages show that Camelot Crater was formed by an impact approximately 95 m.y. ago. After a short summary of the lunar timetable as it stands at the end of the Apollo program, we report about Ar-39/Ar-40 and rare gas studies on the Malvern meteorite. This achondrite resembles lunar highland breccias in texture as well as in rare-gas patterns. It was strongly annealed at some time between 3.4 and 3.8 b.y. ago. The results indicate that very similar processes have occurred on the Moon and on achondritic parent bodies at comparable times, leading to impact breccias with strikingly similar features, including the retention of rare-gas isotopes from various sources. Author

N78-12961*# Bristol Univ. (England). School of Chemistry.
THE EXPOSURE HISTORY OF THE APOLLO 16 SITE: AN ASSESSMENT BASED ON METHANE AND HYDROLYSABLE CARBON
C. T. Pillinger, G. Eglinton, A. P. Gowar, A. J. T. Jull, and J. R. Maxwell *In* NASA, Washington The Soviet-Am. Conf. on Cosmochem. of the Moon and Planets, Pt. 2 1977 p 541-551 refs (For availability see N78-12958 03-90)

Avail: NTIS MF A01; SOD HC CSCL 03B

Nineteen soils from eight stations at the Apollo 16 landing site have been analyzed for methane and hydrolysable carbon. These results, in conjunction with published data from photogeology, bulk chemistry, rare gases, primordial and cosmogenic radionuclides, and agglutinate abundances have been interpreted in terms of differing contributions from three components-North and South Ray Crater ejecta and Cayley Plains material. Author

N78-12962*# California Univ., Los Angeles. Dept. of Planetary and Space Science.

PRE-MARE CRATERING AND EARLY SOLAR SYSTEM HISTORY

G. W. Wetherill *In* NASA, Washington The Soviet-Am. Conf. on Cosmochem. of the Moon and Planets, Pt. 2 1977 p 553-567 refs (For availability see N78-12958 03-90)

Avail: NTIS MF A01; SOD HC CSCL 03B

An evaluation of the application of the high extralunar flux in pre-mare times to more general problems of early solar system history is attempted by combining the results of dynamic studies with lunar chronological data. There is a twofold to fourfold contrast in the integral impact flux between the Apollo 14 and 16 sites and the older mare surfaces. This is judged insufficient to account for the contrasting lithology between these two sites: basalts and soil breccias in the maria, annealed breccias and impact melts in the highlands. Therefore, these rocks and their ages (3.9-4.0 b.y.) are thought to predate the surfaces in which they are found. Estimation of the flux needed to produce these lithologies, and difficulties associated with extrapolating this further back in lunar history give support to the 'cataclysm' hypothesis of Tera, Papanastassiou, and Wasserburg. Dynamical studies permit separate evaluation of the possible sources for both the 'normal' flux during the first 600 million years of lunar history and the 'peak' that apparently occurred 4.0 billion years ago. The most likely sources for the normal flux are comets from the vicinity of Uranus and Neptune. The most promising source for the peak is tidal disruption by Earth or Venus of a Ceres-size asteroid initially in a Mars-crossing orbit. Alternative possibilities are suggested. Author

N78-12963*# Academy of Sciences (USSR), Moscow.

THE ROLE OF EXOGENIC FACTORS IN THE FORMATION OF THE LUNAR SURFACE

K. P. Florenskiy, A. T. Bazilevskiy, and A. V. Ivanov *In* NASA, Washington The Soviet-Am. Conf. on Cosmochem. of the Moon and Planets, Pt. 2 1977 p 571-584 refs (For availability see N78-12958 03-90)

Avail: NTIS MF A01; SOD HC CSCL 03B

The formation of the surface of planetary bodies is determined by the interaction of endogenic and exogenic forces. Clarification of the mutual role of these forces is one of the most important trends in the geological sciences. Author

N78-12964*# Max-Planck-Institut fuer Kernphysik, Heidelberg (West Germany).

MICROCRATERS ON LUNAR SAMPLES

H. Fechtig, W. Gentner, J. B. Hartung, K. Nagel, G. Neukum, E. Schneider, and D. Storzer (Musee Natl. d'Histoire Naturelle, Paris) *In* NASA, Washington The Soviet-Am. Conf. on Cosmochem. of the Moon and Planets, Pt. 2 1977 p 585-603 refs (For availability see N78-12958 03-90)

Avail: NTIS MF A01; SOD HC CSCL 03B

The lunar microcrater phenomenology is described. The morphology of the lunar craters is in almost all aspects simulated in laboratory experiments in the diameter range from less than 1 nu to several millimeters and up to 60 km/s impact velocity. An empirically derived formula is given for the conversion of crater diameters into projectile diameters and masses for given impact velocities and projectile and target densities. The production size frequency distribution for lunar craters in the crater size range from approximately 1 nu to several millimeters in diameter is derived from various microcrater measurements within a factor of up to 5. Particle track exposure age measurements for a variety of lunar samples have been performed. They allow the conversion of the lunar crater size frequency production distributions into particle fluxes. The development of crater populations on lunar rocks under self-destruction by subsequent meteoroid impacts and crater overlap is discussed and theoretically described. Erosion rates on lunar rocks on the order of several millimeters per 10 yr are calculated. Chemical investigations of the glass linings of lunar craters yield clear evidence of admixture of projectile material only in one case, where the remnants of an iron-nickel micrometeorite have been identified. Author

N78-12965*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

THE MICROMETEOROID COMPLEX AND EVOLUTION OF THE LUNAR REGOLITH

F. Horz, D. A. Morrison, D. E. Gault, V. R. Oberbeck, W. L. Quaide, J. F. Vedder, D. E. Brownlee (Washington Univ., Seattle), and J. B. Hartung (Max Planck Inst. fue Kernphysik, Heidelberg, West Germany) *In its* The Soviet-Am. Conf. on Cosmochem. of the Moon and Planets, Pt. 2 1977 p 605-635 refs (For availability see N78-12958 03-90)

Avail: NTIS MF A01; SOD HC CSCL 03B

Monte Carlo-based computer calculations, as well as analytical approaches utilizing probabilistic arguments, were applied to gain insight into the principal regolith impact processes and their resulting kinetics. Craters 10 to 1500 m in diameter are largely responsible for the overall growth of the regolith. As a consequence the regolith has to be envisioned as a complex sequence of discrete ejecta blankets. Such blankets constitute first-order discontinuities in the evolving debris layer. The micrometeoroid complex then operates intensely on these fresh ejecta blankets and accomplishes only in an uppermost layer of approximately 1-mm thickness. The absolute flux of micrometeoroids based on lunar rock analyses averaged over the past few 10 to the 6th power years is approximately an order of magnitude lower than presentday satellite fluxes; however, there is indication that the flux increased in the past 10 to the 4th power years to become compatible with the satellite data. Furthermore, there is detailed evidence that the micrometeoroid complex existed throughout geologic time. Author

N78-12966*# Geological Survey, Reston, Va.

LUNAR HIGHLANDS BRECCIAS GENERATED BY MAJOR IMPACTS

Odette B. James *In* NASA, Washington The Soviet-Am. Conf. on Cosmochem. of the Moon and Planets, Pt 2 1977 p 637-658 refs (For availability see N78-12958 03-90)

Avail: NTIS MF A01; SOD HC CSCL 03B

The processes that may have been involved in the formation of most of the major types of lunar breccias are discussed. Some of the types of highlands breccias that may have originated in large impacts are identified. Author

N78-12967*# Chicago Univ., Ill.

METEORITIC MATERIAL ON THE MOON

John W. Morgan, R. Ganapathy, Hideo Higuchi, and Edward Anders *In* NASA, Washington The Soviet-Am. Conf. on Cosmochem. of the Moon and Planets, Pt. 2 1977 p 659-689 refs (For availability see N78-12958 03-90)

Avail: NTIS MF A01; SOD HC CSCL 03B

Three types of meteoritic material are found on the moon: micrometeorites, ancient planetesimal debris from the 'early intense bombardment,' and debris of recent, craterforming projectiles. Their amounts and compositions have been determined from trace element studies. The micrometeorite component is uniformly distributed over the entire lunar surface, but is seen most clearly in mare soils. It has a primitive, C1-chondrite-like composition, and comprises 1 to 1.5 percent of mature soils. Apparently it represents cometary debris. The ancient component is seen in highland breccias and soils. Six varieties have been recognized, differing in their proportions of refractories (Ir, Re), volatiles (Ge, Sb), and Au. All have a fractionated composition, with volatiles depleted relative to siderophiles. The abundance patterns do not match those of the known meteorite classes. These ancient meteoritic components seem to represent the debris of an extinct population of bodies (planetisimals, moonlets) that produced the mare basins during the first 700 Myr of the moon's history. On the basis of their stratigraphy and geographic distribution, five of the six groups are tentatively assigned to specific mare basins: Imbrium, Serenitatis, Crisium, Nectaris, and Humorum or Nubium. Author

N78-12968*# Moscow State Univ. (USSR)
PRIMARY COSMIC RAYS ON THE LUNAR SURFACE
S. N. Vernov and A. K. Lavrukhina *In* NASA, Washington The Soviet-Am. Conf. on Cosmochem. of the Moon and Planets, Pt. 2 1977 p 691-696 refs (For availability see N78-12958 03-90)
Avail: NTIS MF A02; SOD HC CSCL 03B

Results are reported for determination of the galactic cosmic ray flux during various time intervals in the 1965-1972 period, on the basis of data from the instruments of a spacecraft that made a soft landing on the lunar surface, and from the radioactivity of samples returned by the spacecraft. During minimum solar activity (the second half of 1965 and the beginning of 1966) I sub 0 (E greater than or equal to 30 percent MeV/nucleon) was determined to be 0.43 (plus or minus 10 percent). These values, within the error limits of the determinations, agree with the corresponding values of galactic cosmic ray intensities determined by stratospheric measurements. The mean flux of galactic cosmic rays over the past million years is equal to I (E greater or equal to 100 MeV/nucleon) + 0.28 (plus or minus 20 percent). This value agrees with the mean flux of modulated cosmic rays during the period of the nineteenth solar cycle. The mean flux of solar protons between 1965 and 1972 was 2.46.
Author

N78-12969*# National Aeronautics and Space Administration, Washington, D. C.
RESULTS OF SPECIAL MECHANICAL ANALYSES OF LUNA 16 MATERIAL
H. Stiller (Akademie der Wissenschaften der DDR, Potsdam, East Germany), H. Vollstaedt (Akademie der Wissenschaften der DDR, Potsdam, East Germany), R. Wasch (Akademie der Wissenschaften der DDR, Potsdam, East Germany), P. Bankwitz (Akademie der Wissenschaften der DDR, Potsdam, East Germany), E. Bankwitz (Akademie der Wissenschaften der DDR, Potsdam, East Germany), F. C. Wagner (Akademie der Wissenschaften der DDR, Potsdam, East Germany), and J. Schoen (Section Geowissenschaften, Freiberg (SA), East Germany) *In its* The Soviet-Am. Conf. on Cosmochem. of the Moon and Planets, Pt. 2 1977 p 697-702 refs (For availability see N78-12958 03-90)
Avail: NTIS MF A01; SOD HC CSCL 03B

The studies carried out on the Luna 16 regolith have confirmed the data that were already published internationally. By means of activation analysis under irradiation in the reactor, activation analysis with a 14 MeV U-generator, and mass spectroscopy on samples of 10 or 20 mg, six main and 63 trace elements were quantitatively determined and compared with known data.
Author

N78-12970*# Bristol Univ. (England).
THE ANALYSIS OF VARIOUS SIZE, VISUALLY SELECTED AND DENSITY AND MAGNETICALLY SEPARATED FRACTIONS OF LUNA 16 AND 20 SAMPLES
G. Eglinton, A. P. Gowar, A. J. T. Jull, C. T. Pillinger, S. O. Agrell (Cambridge Univ.), J. E. Agrell (Cambridge Univ.), J. V. P. Long (Cambridge Univ.), S. H. U. Bowie (Inst. of Geological Sciences, London), P. R. Simpson (Inst. of Geological Sciences, London), R. D. Beckinsale (Inst. of Geological Sciences, London) et al *In* NASA, Washington the Soviet-Am. Conf. on Cosmochem. of the Moon and Planets, Pt. 2 1977 p 703-727 refs (For availability see N78-12958 03-90)
Avail: NTIS MF A01; SOD HC CSCL 03B

Samples of Luna 16 and 20 have been separated according to size, visual appearance, density, and magnetic susceptibility. Selected aliquots were examined in eight British laboratories. The studies included mineralogy and petrology, selenochronology, magnetic characteristics, Mossbauer spectroscopy, oxygen isotope ratio determinations, cosmic ray track and thermoluminescence investigations, and carbon chemistry measurements. Luna 16 and 20 are typically mare and highland soils, comparing well with their Apollo counterparts, Apollo 11 and 16, respectively. Both soils are very mature (high free iron, carbide, and methane and cosmogenic Ar), while Luna 16, but not Luna 20, is characterized by a high content of glassy materials. An aliquot of anorthosite fragments, handpicked from Luna 20, had a gas retention age of about 4.3 plus or minus 0.1 Gy.
Author

N78-12971*# Ceskoslovenska Akademie Ved, Brno.
MOSSBAUER SPECTROSCOPY OF IRON IN THE LUNA 20 REGOLITH
T. Zemcik and K. Raclavsky (Mining Univ. of Astrava, Czechoslovakia) *In* NASA, Washington The Soviet-Am. Conf. on Cosmochem. of the Moon and Planets, Pt. 2 1977 p 729-734 refs (For availability see N78-12958 03-90)
Avail: NTIS MF A01; SOD HC CSCL 03B

Results of the Mossbauer effect measurements of Fe-57 in the average sample of the Luna 20 regolith, and their comparison with similar measurements of the Luna 16 samples are presented. Room temperature measurements of the nonmagnetic as well as magnetic components of the spectra were performed. By careful least-squares analysis, six quadrupole doublets in the inner parts of spectra were resolved. According to their splittings, they were interpreted as four types of iron in silicates (olivine, two inequivalent pyroxene sites, and a glassy fraction) and two types of nonmagnetic iron-titanium oxides (ilmenite and a spinel). Velocity-window measurements, were used to determine the average nickel content of (2.01 plus or minus 0.84) wt. %. These results are discussed in terms of distribution of iron among different phases. In comparison with the Luna 16 sample, the Luna 20 sample contains more olivine and less ilmenite as well as metal with a slightly higher nickel content.
Author

N78-12972*# Academy of Sciences (USSR), Moscow.
THE MAIN PECULIARITIES OF THE PROCESSES OF THE DEFORMATION AND DESTRUCTION OF LUNAR SOIL
A. K. Leonovich, V. V. Gromov, A. D. Dmitriyev, V. N. Penetrigov, P. S. Senevov, and V. V. Shvarev *In* NASA, Washington The Soviet-Am. Conf. on Cosmochem. of the Moon and Planets, Pt. 2 1977 p 735-743 refs (For availability see N78-12958 03-90)
Avail: NTIS MF A01; SOD HC CSCL 03B

The main results of study of the physical and mechanical properties of lunar soil, obtained by laboratory study of samples returned from the moon by Luna 16 and Luna 20, as well as by operation of the self-propelled Lunokhod 1 and Lunokhod 2 on the surface of the moon, are analyzed in the report. All studies were carried out by single methods and by means of unified instruments, allowing a confident comparison of the results obtained. The investigations conducted allowed the following values of the main physical-mechanical properties of lunar soil to be determined: in the natural condition the solid density corresponds to the porosity of 0.8; the modal value of the carrying capacity is 0.4 kg/square cm; adhesion is 0.04 to 0.06 kg/square cm; and the internal angle of friction is 20 to 25 degree. The main mechanisms of deformation and destruction of the soil are analyzed in the report, and the relationships between the mechanical properties and physical parameters of the soil are presented.
Author

N78-12973*# Academy of Sciences (USSR), Moscow.
THE RADIATION HISTORY OF MATERIAL RETURNED BY THE SOVIET AUTOMATIC STATIONS LUNA 16 AND LUNA 20, ACCORDING TO TRACK STUDIES
L. L. Kashkarov, L. I. Genayeva, and A. K. Lavrukhina *In* NASA, Washington The Soviet-Am. Conf. on Cosmochem. of the Moon and Planets, Pt. 2 1977 p 745-754 refs (For availability see N78-12958 03-90)
Avail: NTIS MF A01; SOD HC CSCL 03B

Fission tracks formed by the vH (very heavy) nuclei group of solar and galactic cosmic rays have been studied in silicate minerals of the lunar regolith returned by the Luna 16 and Luna 20 unmanned spacecraft. It is shown that the material in the Luna 16 core sample, from a typical mare region of the lunar surface, has undergone stronger irradiation by cosmic rays than material returned a highland region by Luna 20. A low-irradiation component (about 10 percent of the total number of crystals) has been found in the Luna 20 core sample materials, which can possibly be attributed to material added to the main bulk of the regolith in the formation of the crater Apollonius C. From the track density distribution of crystals, as a function of depth in the regolith core sample, it follows that the process of formation of the upper layer of the regolith, both for the lunar mare and for the highland region, includes sequential layering of finely crushed crystalline matter and subsequent mixing of it by micrometeorite bombardment. A portion of the crystals with

a very high track density may be a component added to the lunar surface from outer space. Author

N78-12974*# Academy of Sciences (USSR), Moscow. Shternberg State Astronomical Inst.
ANTIPODES ON THE MOON
Yu. N. Lipskiy and Zh. F. Rodionova *In* NASA, Washington The Soviet-Am. Conf. on Cosmochem. of the Moon and Planets, Pt. 2 1977 p 755-761 refs (For availability see N78-12958 03-90)
Avail: NTIS MF A01; SOD HC CSCL 03B

The areas of the maria were determined using a photomap of the visible hemisphere at a scale of 1:5 million and segments of a lunar globe. The results of the measurements of areas of the maria are presented, together with the data of Westfall and Shoemaker and Hackmann. The areas of circular maria, measured from the peaks of the surrounding ridges, and their mean diameters calculated from the area are also presented. Author

N78-12975*# Academy of Sciences (USSR), Moscow.
MEASUREMENT OF THE OPTICAL PROPERTIES OF LUNAR ROCKS IN THE TRANSITION ZONE, RESULTING FROM OBSERVATIONS MADE BY LUNOKHOD 2
Yu. N. Lipskiy and V. V. Shevchenko *In* NASA, Washington The Soviet-Am. Conf. on Cosmochem. of the Moon and Planets, Pt. 2 1977 p 763-767 refs (For availability see N78-12958 03-90)
Avail: NTIS MF A01; SOD HC CSCL 03B

Photometric measurements were carried out directly on the lunar surface with the aid of a calibration device, a plate with fields of different brightness, placed in the field of view of the panoramic telephotometers. The brightness of the fields of the calibration plate were measured in preliminary studies, relative to the brightness of a magnesia screen. This permitted determination of the reflectance features of the surficial lunar material relative to the standard most widely used in brightness studies of natural substances. The total brightness of sections a few centimeters across was recorded in direct proximity to the apparatus. The total area investigated in one panorama was about one square meter. Several areas in the mare and highland regions were studied. The albedos of various surface objects were obtained. A comparison of the brightness measurements with data from the RIFMA-M instrument discloses a correlation of the albedo change with change in chemical composition of the surface rock. Direct photometric studies of the lunar surface in the 'mare-highland' transition zone assist in tracing the transition from one type of rock to another, and in obtaining information on the processes of material exchange between these two types of lunar landscape. Author

N78-12976*# California Univ., Berkeley. Dept. of Physics.
CLUES IN THE RARE GAS ISOTOPES TO EARLY SOLAR SYSTEM HISTORY
John H. Reynolds *In* NASA, Washington The Soviet-Am. Conf. on Cosmochem. of the Moon and Planets, Pt. 2 1977 p 771-780 refs (For availability see N78-12958 03-90)
Avail: NTIS MF A01; SOD HC CSCL 03B

The results of the radioactive dating and the discovery of gas-rich meteorites on the Moon surface are reviewed. Special attention is paid to the extinct radioactivity iodine-129. This radioactivity is produced by r-process of nucleosynthesis and it decays with a half-life of 17 m.y. It provides a clock sensitive to small changes in the early years of the solar system. I.M.

N78-12977*# Chicago Univ., Ill. Dept. of Chemistry and Geophysical Sciences.
HETEROGENEITIES IN THE SOLAR NEBULA
Robert N. Clayton, Lawrence Grossman, Toshiko K. Mayeda, and Naoki Onuma (Tokyo Gakugei Univ., Japan) *In* NASA, Washington The Soviet-Am. Conf. on Cosmochem. of the Moon and Planets, Pt. 2 1977 p 781-785 refs (For availability see N78-12958 03-90)
Avail: NTIS MF A01; SOD HC CSCL 03B

Oxygen isotopic compositions of the high-temperature phases in carbonaceous chondrites define a mixing line with an O-16-rich component and show little superimposed chemical isotope fractionation. Within a single inclusion in Allende, variations of delta O-18 and delta O-17 of 39 thousands are found. The ordinary chondrites are slightly displaced from the terrestrial fractionation trend, implying that at least 0.2 percent of the oxygen in terrestrial rocks was derived from the O-16-rich component. Author

N78-12978*# Chicago Univ., Ill. Dept. of the Geophysical Sciences.
CHEMICAL FRACTIONATION IN THE SOLAR NEBULA
Lawrence Grossman *In* NASA, Washington The Soviet-Am. Conf. on Cosmochem. of the Moon and Planets, Pt. 2 Jul. 1977 p 787-796 refs (For availability see N78-12958 03-90)
Avail: NTIS MF A01; SOD HC CSCL 03B

The sequence of condensation of minerals from a cooling gas of solar composition has been calculated from thermodynamic data over the pressure range 0.001-0.00001 atm, assuming that complete chemical equilibrium is maintained. The results suggest that the Ca-Al-rich inclusions Allende and other carbonaceous chondrites are aggregates of the highest temperature condensates. Complete condensation of these elements is followed, 100 deg later, by the onset of the crystallization of nickel-iron, forsterite and enstatite. Transport of Ca-Al-rich refractory condensates from one part of the nebula to another before the condensation of these lower-temperature phases may have been responsible for the refractory element fractionations between the different classes of chondrites and possibly for the inferred refractory element enrichment of the Moon. The temperature gap between the condensation temperatures of nickel-iron and forsterite increases with increasing total pressure. Because pressure and temperature probably increased with decreasing heliocentric distance in the solar nebula, Mercury may have accreted from a condensate assemblage having a higher metal/silicate ratio than Venus or Earth which may, in turn, have formed from less oxidized material than Mars. Author

N78-12979*# Academy of Sciences (USSR), Moscow.
TIME SCALE FOR THE FORMATION OF THE EARTH AND PLANETS AND ITS ROLE IN THEIR GEOCHEMICAL EVOLUTION
V. S. Safronov *In* NASA, Washington The Soviet-Am. Conf. on Cosmochem. of the Moon and Planets, Pt. 2 1977 p 797-803 refs (For availability see N78-12958 03-90)
Avail: NTIS MF A01; SOD HC CSCL 03B

The initial mass of the solar nebula is discussed. Models of a massive nebula (two solar masses and more) encounter serious difficulties: an effective mechanism of transfer of the momentum from the central part of the nebula outward, capable of leading to formation of the sun and removal of half the mass of the nebula from the solar system has not been found. As a consequence of the instability of these models, their evolution can end with the formation, not a planetary system, but of a binary star. The possibility is demonstrated of obtaining acceptable growth rates for Uranus and Neptune by prolonging the thickening of preplanetary dust in the region of large masses. The important role of large bodies in the process of formation of the planets is noted. The impacts of such bodies, moving in heliocentric orbits, could have imparted considerable additional energy to the forming Moon, which, together with the energy given off by the joining of a small number of large protomoons, could have led to a high initial temperature of the moon. Author

N78-12980*# California Univ., Los Angeles.
MECHANICAL PROCESSES AFFECTING DIFFERENTIATION OF PROTOLUNAR MATERIAL
W. M. Kaula *In* NASA, Washington The Soviet-Am. Conf. on Cosmochem. of the Moon and Planets, Pt. 2 1977 p 805-813 refs (For availability see N78-12958 03-90)
Avail: NTIS MF A01; SOD HC CSCL 03B

Mechanisms prior to lunar formation are sought to account for the loss of volatiles, the depletion of iron, and the enrichment of plagioclase. Some of the same mechanisms are necessary to account for achondritic, stony-iron, and iron meteorites. Collisions seem marginally capable of providing the heat to accomplish the differentiation into iron, magnesian silicates, and plagioclase. Once this differentiation is accomplished, the subsequent mechanical history should have been sufficient to sort material according to composition in the protolunar circumterrestrial cloud. Effects operating include the correlation of body size with mechanical strength; the lesser ability of the cloud to trap the

larger, denser infalling bodies; the more rapid drawing into the Earth of the larger moonlets; and the higher energy orbits for dominantly plagioclase smaller pieces broken off by collision.
Author

N78-12981*# Academy of Sciences (USSR), Moscow. O. Yu. Schmidt Inst. of Earth Physics.
THE ORIGIN OF THE MOON
Ye. L. Ruskol *In* NASA, Washington The Soviet-Am. Conf. on Cosmochem. of the Moon and Planets, Pt. 2 1977 p 815-822 refs (For availability see N78-12958 03-90)
Avail: NTIS MF A01; SOD HC CSCL 03B

The fractionation of the chemical compositions of the moon and the earth and the thermal history of the moon for formation of the moon from an earth-orbiting swarm of bodies during the accumulation of the earth are discussed. Author

N78-12982*# California Inst. of Tech., Pasadena. Seismological Lab.
FORMATION AND COMPOSITION OF THE MOON
Don L. Anderson *In* NASA, Washington The Soviet-Am. Conf. on Cosmochem. of the Moon and Planets, Pt. 2 1977 p 823-845 refs (For availability see N78-12958 03-90)
Avail: NTIS MF A01; SOD HC CSCL 03B

Many of the properties of the Moon, including the enrichment in Ca, Al, Ti, U, Th, Ba, Sr, and the REE and the depletion in Fe, Rb, K, Na, and other volatiles can be understood if the Moon represents a high-temperature condensate from the solar nebula. Thermodynamic calculations show that Ca-, Al-, and Ti-rich compounds condense first in a cooling nebula. The initial high temperature mineralogy is gehlenite, spinel, perovskite, Ca-Al-rich pyroxenes, and anorthite. Inclusions in carbonaceous chondrites such as the Allende meteorite are composed primarily of these minerals and, in addition, are highly enriched in refractories such as REE relative to carbonaceous chondrites. These inclusions can yield basalt and anorthosite in the proportions required to eliminate the europium anomaly, leaving a residual spinel-melilite interior. A deep interior high in Ca-Al does not imply an unacceptable mean density or moment of inertia for the Moon. The inferred high-U content of the lunar interior, both from the Allende analog and the high heat flow, indicates a high-temperature interior. The model is consistent with extensive early melting, with shallow melting at 3 AE, and with presently high deep internal temperatures. It is predicted that the outer 250 km is rich in plagioclase and FeO. The low iron content of the interior in this model raises the interior temperatures estimated from electrical conductivity by some 800 C. Author

N78-12983*# Princeton Univ., N. J.
THE INTERIOR STRUCTURE OF JUPITER (CONSEQUENCES OF PIONEER 10 DATA)
R. Smoluchowski *In* NASA, Washington The Soviet-Am. Conf. on Cosmochem. of the Moon and Planets, Pt. 2 1977 p 849-858 refs (For availability see N78-12958 03-90)
Avail: NTIS MF A01; SOD HC CSCL 03B

Models of the Jovian interiors based on theoretical equations of state of hydrogen and helium supported by a few experimental points and on observed parameters such as oblateness, gravitational coefficients, heat emission, magnetic fields, are discussed. The models fall into three categories: (1) those that assume a uniform and rather low H2/He ratio throughout the planet; (2) those in which this ratio is solar and thus higher; and (3) those that take into account the lack of complete miscibility of the two elements in the condensed state. It appears now also that within the limits of error the planet is in a hydrostatic equilibrium. The large heat emission and the need for an efficient source of internal heat are confirmed, but the results do not indicate which one of the various possible mechanisms is favored, although new evolutionary models suggest that the primordial heat may be insufficient. A new red spot has been discovered. Finally, the presence of a highly eccentric and inclined magnetic field poses new problems related to the pattern of internal convection and to the possibility of a north-south asymmetry of the interior. Further analysis of the available data may throw additional light on these questions. Author

N78-12984*# Academy of Sciences (USSR), Moscow. Inst. for Space Research.
THE MAGNETIC FIELD OF MARS ESTIMATED FROM THE DATA OF PLASMA MEASUREMENTS BY SOVIET ARTIFICIAL SATELLITES OF MARS
K. I. Gringauz, V. V. Bezrukikh, T. K. Breus, M. I. Verigin, and A. P. Remizov *In* NASA, Washington The Soviet-Am. Conf. on Cosmochem. of the Moon and Planets, Pt. 2 1977 p 859-863 refs (For availability see N78-12958 03-90)
Avail: NTIS MF A01; SOD HC CSCL 03B

The dimensions of the obstacle forming the shock wave of Mars are estimated by use of electron trap data from Mars 2, 3, and 5. The mean altitude of the obstacle at the subsolar point can be convincingly explained if the obstacle is the magnetosphere of Mars. On the assumption that Mars has its own dipole magnetic field, the magnetic moment of Mars is estimated, Mm approximately equal to 2 x 10 to the twenty second power gs x cubic cm. Author

N78-12985*# California Inst. of Tech., Pasadena.
TELEVISION OBSERVATIONS OF MERCURY BY MARINER 10
Bruce C. Murray, Michael J. S. Belton (Arizona Univ., Tucson, Ariz.), Edward G. Danielson (Jet Propulsion Lab, Pasadena, Calif.), Merton E. Davies (Rand Corp., Santa Monica, Calif.), Donald E. Gault (Ames Research Center, Moffett Field, Calif.), Bruce Hapke (Pittsburgh Univ., Pa.), Brian OLeary (Hampshire Coll., Amherst, Mass.), Robert G. Strom, Verner Suomi (Wisconsin Univ., Madison), Newell Trask (U.S. Geological Survey, Reston, Va.) et al *In* NASA, Washington The Soviet-Am. Conf. on Cosmochem. of the Moon and Planets, Pt. 2 1977 p 865-885 refs (For availability see N78-12958 03-90)
Avail: NTIS MF A01; SOD HC CSCL 03B

The morphology and optical properties of the surface of Mercury resemble those of the Moon in remarkable detail, recording a very similar sequence of events; chemical and mineralogical similarity of the outer layers is implied. Mercury is probably a differentiated planet with an iron-rich core. Differentiation is inferred to have occurred very early. No evidence of atmospheric modification of any landform is found. Large-scale scarps and ridges unlike lunar or Martian features may reflect a unique period of planetary compression near the end of heavy bombardment, perhaps related to contraction of the core. Author

N78-12986*# State Univ. of New York, Stony Brook.
STUDIES OF CHEMICAL ABUNDANCES IN THE OUTER SOLAR SYSTEM
Tobias Owen *In* NASA, Washington The Soviet-Am. Conf. on Cosmochem. of the Moon and Planets, Pt. 2 1977 p 887-892 refs (For availability see N78-12958 03-90)
Avail: NTIS MF A01; SOD HC CSCL 03B

Ground-based observations and the Pioneer 10 mission have led to new discoveries and revisions of previous ideas about the outer solar system. Among these are the discovery of atmospheres on Io and Ganymede, emission from sodium and hydrogen in a cloud around Io, and the presence of acetylene, ethane, and phosphine in the atmosphere of Jupiter. Titan, the largest satellite of Saturn, continues to be an extremely interesting and baffling object, clearly very different in composition from the bodies we are familiar with in the inner solar system; this is also true of Ganymede and Callisto. New data on the abundances of methane and hydrogen in the atmospheres of Uranus and Neptune suggest that the values of C/H in these atmospheres may be much lower than had been previously thought. This result reinforces the apparent compositional differences between these two planets and Jupiter and Saturn, whose atmospheres exhibit a near-solar value for this ratio. Author

N78-12987*# Massachusetts Inst. of Tech., Cambridge. Dept. of Earth and Planetary Sciences.
USE OF GROUND-BASED TELESCOPES IN DETERMINING THE COMPOSITION OF THE SURFACES OF SOLAR SYSTEM OBJECTS
Thomas B. McCord and John B. Adams (Fairleigh Dickinson Univ., St. Croix, Virgin Islands) *In* NASA, Washington The Soviet-Am. Conf. on Cosmochem. of the Moon and Planets, Pt. 2 1977 p 893-922 refs (For availability see N78-12958 03-90)
Avail: NTIS MF A01; SOD HC CSCL 03B

Recent evidence suggests that the way that the surfaces of

the solar system objects reflect solar radiation is controlled by the composition and mineralogy of the surface materials. The way sunlight is reflected from the surface as a function of wavelength, i.e., the spectral reflectance, is the most important property. Laboratory efforts to use ground-based optical telescope measurements to determine the composition of the surfaces of the solar system objects are reviewed. Author

N78-12988*# Massachusetts Inst. of Tech., Cambridge.
COMETS: DATA, PROBLEMS, AND OBJECTIVES
Fred L. Whipple *In* NASA, Washington The Soviet-Am. Conf. on Cosmochem. of the Moon and Planets, Pt. 2 1977 p 923-929 refs (For availability see N78-12958 03-90)
Avail: NTIS MF A01; SOD HC CSCL 03B

A highly abridged review of new relevant results from the observations of Comet Kohoutek is followed by an outline summary of our basic knowledge concerning comets, both subjects being confined to data related to the nature and origin of comets rather than the phenomena (for example, plasma phenomena are omitted). The discussion then centers on two likely places of cometary origin in the developing solar system, the proto-Uranus-Neptune region versus the much more distant fragmented interstellar cloud region, now frequented by comets of the Opik-Oort cloud. The Comet Kohoutek results add new insights, particularly with regard to the parent molecules and the nature of meteoric solids in comets, to restrict the range of the physical circumstances of comet formation. A few fundamental and outstanding questions are asked, and a plea made for unmanned missions to comets and asteroids in order to provide definitive answers as to the nature and origin of comets, asteroids, and the solar system generally. Author

91 LUNAR AND PLANETARY EXPLORATION

Includes planetology; and manned and unmanned flights.

For spacecraft design see *18 Spacecraft Design Testing, and Performance*. For space stations see *15 Launch Vehicles and Space Vehicles*.

N78-12989 Florida Univ., Gainesville.
UNDERLYING PROCESSES OF THE JOVIAN DECAMETRIC RADIATION Ph.D. Thesis
James Richard Kennedy 1976 223 p
Avail: Univ. Microfilms Order No. 77-17028

The excitation of decametric radiation in Jupiter by sources other than the satellite Io was investigated. Two models for solar wind velocity stream interactions were developed to determine a possible correlation between the radio sources activity and density waves in the solar wind. The activity occurence spectra was examined for evidence of periodicity, and the possibility that the non Io component was the result of some intrinsic random process was explored. Below the strata of events known to be associated with Io, there are secondary and tertiary exciters which influence the non-random emission in the 18 to 27 MHz regions. Dissert. Abstr.

N78-12990*# Argonne National Lab., Ill.
VOLATILE METAL DEPOSITS ON LUNAR SOILS: RELATION TO VOLCANISM
G. W. Reed, Jr., R. O. Allen, Jr., and S. Jovanovic 1977 28 p refs Presented at Lunar Sci. Conf., Houston, Tex., 14-18 Mar. 1977 Sponsored in part by NASA
(Contract W-31-109-eng-38)
(NASA-CR-155289; CONF-770322-2) Avail: NTIS HC A03/MF A01 CSCL 03B

Parallel leaching and volatilization experiments conducted on lunar samples and similar experiments on sphalerite do not supply the information needed to resolve the question of the chemical nature of pb 204, Zn, Bi and Tl deposits on lunar soil surfaces. It is proposed that in Apollo 17 mare and terra soils and fractions of pb 204, Zn and Tl that are insoluble under mild, hot pH 5HNO3, leaching conditions and involatile at 600 C were originally surface deposits which became immobilized by migration into the silicate substrate or by chemisorption. Only Bi is predominantly indigenous. The implication is also that the soils over their respective times of evolution were exposed to heavy metal vapors or that an episodic exposure occurred after they had evolved. A sequence of events is proposed to account for orange 74220 and black 74001 glasses by lava fountaining and for soil 74241 as tephra from an explosive volcanic eruption. ERA

92 SOLAR PHYSICS

Includes solar activity, solar flares, solar radiation and sunspots.

N78-12991*# Teledyne Brown Engineering, Huntsville, Ala. Engineering Services Div.
RESEARCH IN SOLAR PHYSICS: ANALYSIS OF SKYLAB/ ATM S-056 X-RAY DATA Interim Report
W. Henze, Jr. Oct. 1977 80 p refs
(Contract NAS8-31908)
(NASA-CR-150470; ESD-MSFC-2145) Avail: NTIS HC A05/MF A01 CSCL 03B

Data obtained by the X-ray event analyzer are described as well as methods used for film calibration. Topics discussed include analyses of the 15 June 1973 flare, oscillations in the solar soft X-ray flux, and deconvolution of X-ray images of the 5 September 1973 flare. Author

N78-12992*# Naval Research Lab., Washington, D. C.
NRL/ATM USER'S GUIDE TO EXPERIMENT S082A
Irene G. Packer (Hulbert (E. O.) Center for Space Res.), N. Paul Patterson (Ball Bros. Res. Corp., Boulder, Colo.), Stephen A. Mango (Ball Bros. Res. Corp., Boulder, Colo.), and Richard Tousey (Hulburt (E. O.) Center for Space Res.) Feb. 1977 123 p refs
(NASA Order S-60604-G)
(NASA-CR-155369; AD-A044548; NRL-MR-3410) Avail: NTIS HC A06/MF A01 CSCL 03/2

Almost perfect operation of Skylab Experiment S082A resulted in the return of 1032 extreme ultraviolet solar spectroheliograms, providing an enormous wealth of new information about the sun in the wavelength range 171 to 630. The present User's Guide was written for guest investigators and other ATM experimenters who will collaborate in interpreting the returned data. The first section is devoted to a brief overview of the Apollo Telescope Mount (ATM) as a whole and the major areas in which the data have been found to be most important. There follows a detailed description of the spectroheliograph and the special Schumann film it utilized. The complementary relationship to the 5 other major instruments on ATM is explained. A large portion of the Guide is devoted to a description of the observations, the data catalogs and documentation, and listings of important events recorded during almost 9 months of nearly continuous operation of Skylab, beginning in May 1973. The main part of the Guide describes filmed copies of the data available from the National Space Science Data Center (NSSDC), Greenbelt, Maryland. A thorough discussion of how to extract data from the photographic images includes a special section on the derivation of relative intensity values. The Appendix contains an extensive bibliography of papers on the ATM results published by the Naval Research Laboratory data analysis team. A spectroheliogram overlay scaled to the NSSDC film identifies prominent spectral features. Author (GRA)

N78-12993# National Geophysical and Solar-Terrestrial Data Center, Boulder, Colo.
SOLAR-GEOPHYSICAL DATA NUMBER 394. PART 1: PROMPT REPORTS. DATA FOR MAY 1977 - APRIL 1977
Helen E. Coffey Jun. 1977 123 p
(PB-271322/0; SGD-394-Pt-1; NOAA-77071801-Pt-1) Avail: NTIS HC A06/MF A01 CSCL 03B

Data are provided for May 1977 on: alert periods, daily solar indices, solar flares, solar radio waves, solar X-ray radiation, coronal holes, spacecraft observations, solar wind measurements, inferred IP magnetic field polarities and mean solar magnetic field. Data are also provided for April 1977 on:

daily solar activity center, sudden ionospheric disturbances, solar radio waves, cosmic rays, geomagnetic indices, and radio propagation indices. GRA

N78-12994# National Geophysical and Solar-Terrestrial Data Center, Boulder, Colo.
SOLAR-GEOPHYSICAL DATA NUMBER 394. PART 2: COMPREHENSIVE REPORTS. DATA FOR DECEMBER 1976 - NOVEMBER 1976 AND MISCELLANEA
Helen E. Coffey Jun. 1977 42 p
(PB-271323/8; SGD-394-Pt-2; NOAA-77071802-Pt-2) Avail: NTIS HC A03/MF A01 CSCL 03B

Data were reported for December 1976, and November 1976 on: active regions, synoptic solar map, solar flares, solar radio waves, energetic solar particles and plasma, synoptic chart, abbreviated calendar record, regional flare index, and cosmic rays. GRA

93 SPACE RADIATION

Includes cosmic radiation and inner and outer earth's radiation belts.

For biological effects of radiation see *52 Aerospace Medicine*. For theory see *73 Nuclear and High-Energy Physics*.

N78-12995 California Univ., Berkeley.
ENERGETIC HEAVY CHARGED PARTICLES IN THE RADIATION BELT AS OBSERVED ON SKYLAB Ph.D. Thesis
John Hong-Kung Chan 1976 63 p
Avail: Univ. Microfilms Order No. 77-15628

A high flux of particles ranging from oxygen to iron in the energy interval 10 less than E less than 40 MeV/nuc was detected on Skylab at 400 km. altitude. All elements exhibit a steeply falling spectrum. The composition was O:Ne(Na-Si):Fe 100:25:16:1 at 20 MeV/nuc. At 10 MeV/nuc the oxygen fluence for the 73 day period from Nov. 1973 to Feb. 1974 was 53 sq cm-sr-MeV/nuc. An anisotropy in the particles' incident directions on the detector is apparent. Monte Carlo simulations show that the hypothesis of heavy particles in the trapped radiation over Brazilian anomaly with a flux scale height of about 5 km. gives the best agreement with the observed flux and anisotropy. Dissert. Abstr.

99 GENERAL

N78-12996# Advisory Group for Aerospace Research and Development, Paris (France).
AGARD BULLETIN TECHNICAL PROGRAM 1978
Aug. 1977 37 p refs
(AGARD-Bul-77/2) Avail: NTIS HC A03/MF A01

The 1978 program that was approved by the AGARD National Delegates Board is presented. Section I includes a chronological listing of the meetings tentatively scheduled to take place during 1978 and Section II gives a detailed description of the individual Panel Programs, the Consultant and Exchange Program, and the Military Committee Studies Program. The total budget required to support the Proposed 1978 AGARD Technical Program is presented in Section III. The Publication Summary in Section IV identifies by activity the AGARD publications scheduled for initiation and/or publication in 1978. Author

N78-12997*# National Aeronautics and Space Administration, Washington, D. C.
ASTRONAUTICS AND AERONAUTICS, 1974: A CHRONOLOGY NASA History Series
Nancy L. Brun 1977 323 p refs
(NASA-SP-4019; LC-65-60308) Avail: NTIS MF A01; SOD HC $4.90 CSCL 05A

The 14th volume in the NASA series of day-by-day records of aeronautical and space events has somewhat narrowed its scope and selectivity in its brief accounts from immediately available, open sources. This year the emphasis is even more directly focused on concrete air and space activities. The text continues to reflect some events in other agencies and countries. Author

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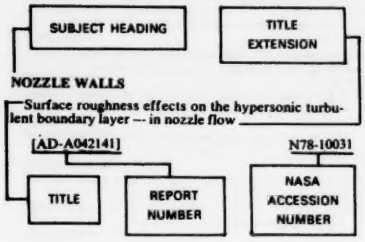

The subject heading is the key to the subject content of the document. Titles, report numbers, and accession numbers of pertinent documents are provided under each subject heading. When the title is insufficiently descriptive of the document content, a title extension has been added, separated from the title by three hyphens. The report number helps to indicate the type of document cited (e.g., NASA report, NASA translation, NASA contractor report). The NASA accession number is the number by which the document abstracts are arranged in this journal and by which the document is sold or requested. The titles, with title extensions if present, are arranged under each subject heading in ascending accession number order. The subject headings have been selected from the latest revision of the *NASA Thesaurus* (NASA SP-7050).

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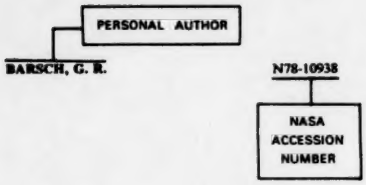

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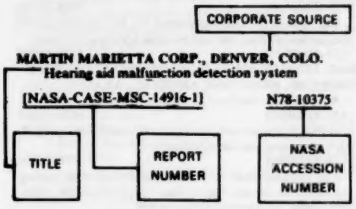

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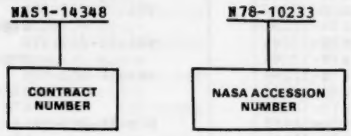

Listings in this index are arranged alphanumerically by contract number. Under each contract number the NASA accession numbers denoting documents that have been produced as a result of research done under that contract are arranged in ascending order. The NASA accession number denotes the number by which the citation is identified.

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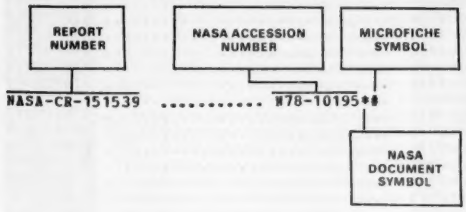

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NASA-CR-151560 ..... N78-12660*#
NASA-CR-154595 ..... N78-12581*#
NASA-CR-155207 ..... N78-12492*#
NASA-CR-155209 ..... N78-12493*#
NASA-CR-155212 ..... N78-12494*#
NASA-CR-155248 ..... N78-12500*#
NASA-CR-155249 ..... N78-12501*#
NASA-CR-155251 ..... N78-12502*#
NASA-CR-155252 ..... N78-12503*#
NASA-CR-155257 ..... N78-12507*#
NASA-CR-155266 ..... N78-12106*#
NASA-CR-155267 ..... N78-12419*#
NASA-CR-155268 ..... N78-12261*#
NASA-CR-155269 ..... N78-12659*#
NASA-CR-155270 ..... N78-12141*#
NASA-CR-155271 ..... N78-12317*#
NASA-CR-155272 ..... N78-12670*#
NASA-CR-155281 ..... N78-12016*#
NASA-CR-155282 ..... N78-12367*#
NASA-CR-155283 ..... N78-12584*#
NASA-CR-155289 ..... N78-12990*#
NASA-CR-155290 ..... N78-12514*#
NASA-CR-155319 ..... N78-12823*#
NASA-CR-155320 ..... N78-12824*#
NASA-CR-155321 ..... N78-12442*#
NASA-CR-155323 ..... N78-12526*#
NASA-CR-155324 ..... N78-12260*#
NASA-CR-155325 ..... N78-12527*#
NASA-CR-155326 ..... N78-12528*#
NASA-CR-155327 ..... N78-12585*#
NASA-CR-155328 ..... N78-12366*#
NASA-CR-155329 ..... N78-12015*#
NASA-CR-155369 ..... N78-12992*#
NASA-CR-156643 ..... N78-12495*#
NASA-CR-156647 ..... N78-12499*#
NASA-CR-156837 ..... N78-12110*#

NASA-RP-1003 ..... N78-12895*#
NASA-RP-1009 ..... N78-12113*#
NASA-RP-1012 ..... N78-12644 #

NASA-SP-370-PT-1 ..... N78-12925*#
NASA-SP-370-PT-2 ..... N78-12958*#
NASA-SP-409 ..... N78-12017*#
NASA-SP-4019 ..... N78-12997*#
NASA-SP-7043(13) ..... N78-12524*+

NASA-TM-X-73950 ..... N78-12895*#
NASA-TM-X-74945 ..... N78-12105*#

NASA-TM-73250 ..... N78-12011*#
NASA-TM-74056 ..... N78-12117*+
NASA-TM-74074 ..... N78-12031*#
NASA-TM-74088 ..... N78-12032*#
NASA-TM-74090 ..... N78-12033*+
NASA-TM-74098 ..... N78-12799*#
NASA-TM-74944 ..... N78-12116*#
NASA-TM-75051 ..... N78-12657*#
NASA-TM-75057 ..... N78-12111*#
NASA-TM-75062 ..... N78-12658*#
NASA-TM-75085 ..... N78-12553*#
NASA-TM-75140 ..... N78-12316*#
NASA-TM-75144 ..... N78-12362*#
NASA-TM-75146 ..... N78-12365*#
NASA-TM-75160 ..... N78-12012*#
NASA-TM-75167 ..... N78-12868*#
NASA-TM-75176 ..... N78-12648*#
NASA-TM-75179 ..... N78-12867*#
NASA-TM-75181 ..... N78-12080*#
NASA-TM-75185 ..... N78-12084*#
NASA-TM-75186 ..... N78-12416*#
NASA-TM-75188 ..... N78-12417*#
NASA-TM-75215 ..... N78-12418*#
NASA-TM-75216 ..... N78-12085*#
NASA-TM-75217 ..... N78-12086*#
NASA-TM-78140 ..... N78-12197*#
NASA-TM-78141 ..... N78-12014*#
NASA-TM-78143 ..... N78-12112*#
NASA-TM-78332 ..... N78-12000*#

NASA-TM-D-8449 ..... N78-12037*#
NASA-TM-D-8513 ..... N78-12036*#

NASA-TP-1013 ..... N78-12800*#
NASA-TP-1038 ..... N78-12554*#
NASA-TP-1039 ..... N78-12645*#
NASA-TP-1044 ..... N78-12038*#
NASA-TP-1047 ..... N78-12039*#
NASA-TP-1048 ..... N78-12801*#
NASA-TP-1049 ..... N78-12223*#
NASA-TP-1066 ..... N78-12829*#
NASA-TP-1076 ..... N78-12040*#
NASA-TP-1078 ..... N78-12041*#
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NASA-TP-1089 ..... N78-12555*#
NASA-TP-1093 ..... N78-12167*#
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NATICK-TR-77-3-CSHEL ..... N78-12675 #

NAVEODFAC-TR-185 ..... N78-12241 #

NAVSEA-HT-043 ..... N78-12252 #

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NBSIR-77-1278 ..... N78-12625 #
NBSIR-77-1304 ..... N78-12411 #

NISC-TRANS-3945 ..... N78-12069 #

NLM-MED-77-05 ..... N78-12897 #

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NOAA-TM-ERL-GLERL-13 ..... N78-12632 #

NOAA-TM-ERL-WMPO-38 ..... N78-12639 #

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NPS-67SF77071 ..... N78-12368 #

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NRL-8095 ..... N78-12321 #
NRL-8131 ..... N78-12268 #
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NSF/RA-770142-VOL-3 ..... N78-12539 #
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NSGD-1-76-001 ..... N78-12646 #

NSWC/DL-TR-3615 ..... N78-12046 #
NSWC/WOL/ME-76-24 ..... N78-12179 #
NSWC/WOL/TR-76-37 ..... N78-12323 #
NSWC/WOL/TR-77-29 ..... N78-12746 #
NSWC/WOL/TR-77-32-VOL-2 ..... N78-12114 #

NUSL-TM-2211-331-69 ..... N78-12805 #

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ONR-CR-213-124-3F ..... N78-12291 #

ONRL-C-9-77 ..... N78-12211 #

ORAU/IEA(M)-77-6 ..... N78-12542 #

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OSU-FPRC-6N1 ..... N78-12431 #

OWRT-A-030-UTAH (1) ..... N78-12904 #
OWRT-A-055-KY(2) ..... N78-12638 #

OWRT-B-046-KY(2) ..... N78-12520 #
OWRT-B-077-MO(4) ..... N78-12559 #

PAPER-76-164 ..... N78-12084*#

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PB-269411/5 ..... N78-12512 #
PB-269568/2 ..... N78-12556 #
PB-269598/9 ..... N78-12397 #
PB-269666/4 ..... N78-12562 #
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PB-269944/5 ..... N78-12567 #
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PB-270084/7 ..... N78-12563 #
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PB-270172/0 ..... N78-12548 #
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PB-270401/3 ..... N78-12243 #
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PB-270408/8 ..... N78-12642 #
PB-270428/6 ..... N78-12550 #
PB-270454/2 ..... N78-12522 #
PB-270459/1 ..... N78-12664 #
PB-270460/9 ..... N78-12663 #
PB-270467/4 ..... N78-12910 #
PB-270468/2 ..... N78-12909 #
PB-270514/3 ..... N78-12398 #
PB-270529/1 ..... N78-12907 #
PB-270543/2 ..... N78-12521 #
PB-270549/9 ..... N78-12566 #
PB-270550/7 ..... N78-12565 #
PB-270552/3 ..... N78-12899 #
PB-270640/6 ..... N78-12559 #
PB-270644/8 ..... N78-12520 #
PB-270647/1 ..... N78-12638 #
PB-270671/1 ..... N78-12904 #
PB-270673/7 ..... N78-12903 #
PB-270676/0 ..... N78-12913 #
PB-270868/3 ..... N78-12625 #
PB-270930/1 ..... N78-12539 #
PB-270931/9 ..... N78-12538 #
PB-271007/7 ..... N78-12911 #
PB-271008/5 ..... N78-12246 #
PB-271012/7 ..... N78-12573 #
PB-271019/2 ..... N78-12912 #
PB-271093/7 ..... N78-12245 #
PB-271099 ..... N78-12244 #
PB-271249/5 ..... N78-12552 #
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PB-271255/2 ..... N78-12640 #
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PB-271291/7 ..... N78-12623 #
PB-271303/0 ..... N78-12905 #
PB-271304/8 ..... N78-12639 #
PB-271306/3 ..... N78-12897 #
PB-271312/1 ..... N78-12646 #
PB-271319/6 ..... N78-12247 #
PB-271322/0 ..... N78-12993 #
PB-271323/8 ..... N78-12994 #
PB-271361/8 ..... N78-12560 #
PB-271362/6 ..... N78-12561 #
PB-271788/2 ..... N78-12621 #

PD-76-107 ..... N78-12618 #

POLY-M/AE-77-12 ..... N78-12384 #
POLY-M/AE-77-14 ..... N78-12386 #

PR-5 ..... N78-12493*#

PREPRINT-4 ..... N78-12316*#

PRJEB030-3 ..... N78-12904 #

PRRL-77-CR-29 ..... N78-12229 #

PSI-TR-91 ..... N78-12405 #

PWA-FR-8499-VOL-1 ..... N78-12081*#
PWA-FR-8499-VOL-2 ..... N78-12082*#

PWA-5522 ..... N78-12087 #
PWA-5551 ..... N78-12088 #

PZIA-77-01 ..... N78-12256 #

QEI-6915 ..... N78-12899 #

QPR-4 ..... N78-12501*#
QPR-7 ..... N78-12880 #

QR-1 ..... N78-12507*#
QR-2 ..... N78-12229 #
QR-2 ..... N78-12336 #
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R-769 ..... N78-12871 #
R-774 ..... N78-12276 #
R-777 ..... N78-12680 #
R-1038 ..... N78-12255 #
R-1042 ..... N78-12062 #
R-2064/1-AF ..... N78-12270 #

RADC-TR-77-272 ..... N78-12284 #

RADC-TR-76-348 ..... N78-12406 #
RADC-TR-77-82-VOL-2 ..... N78-12348 #
RADC-TR-77-100 ..... N78-12618 #
RADC-TR-77-122 ..... N78-12736 #
RADC-TR-77-141 ..... N78-12263 #
RADC-TR-77-142 ..... N78-12331 #
RADC-TR-77-161 ..... N78-12344 #
RADC-TR-77-178 ..... N78-12324 #
RADC-TR-77-215 ..... N78-12704 #
RADC-TR-77-220-VOL-2 ..... N78-12724 #
RADC-TR-77-221 ..... N78-12703 #
RADC-TR-77-260 ..... N78-12269 #
RADC-TR-77-261 ..... N78-12294 #
RADC-TR-77-262 ..... N78-12517 #
RADC-TR-77-263-VOL-2 ..... N78-12279 #
RADC-TR-77-263-VOL-3 ..... N78-12280 #
RADC-TR-77-269 ..... N78-12206 #
RADC-TR-77-271 ..... N78-12683 #
RADC-TR-77-273 ..... N78-12293 #
RADC-TR-77-276 ..... N78-12688 #
RADC-TR-77-277 ..... N78-12262 #
RADC-TR-77-278 ..... N78-12285 #
RADC-TR-77-290-PT-1 ..... N78-12077 #
RADC-TR-77-290-PT-2 ..... N78-12078 #
RADC-TR-77-291 ..... N78-12695 #
RADC-TR-77-293 ..... N78-12709 #
RADC-TR-228 ..... N78-12320 #

RDR-1778-8 ..... N78-12235 #

REPT-1 ..... N78-12106*#
REPT-21-2548 ..... N78-12371 #
REPT-77-8F9-PPODE-R2 ..... N78-12327 #
REPT-77-263-3 ..... N78-12260*#
REPT-001-3 ..... N78-12873 #
REPT-1842 EEG/EET-TR-77-22 ..... N78-12061 #
REPT-1842-EEG/EETET-TR-77-18 ..... N78-12288 #

RPI-MA-ONR-15 ..... N78-12337 #

RR-104 ..... N78-12520 #
RR-105 ..... N78-12638 #

R77-912545-15 ..... N78-12144*#

S-2166 ..... N78-12324 #

S/IS-7702 ..... N78-12733 #

SAI-76-507-BOS ..... N78-12063 #
SAI-77-003-AA ..... N78-12409 #

SAM-TR-77-11 ..... N78-12319 #

SAMSO-TR-77-62 ..... N78-12696 #
SAMSO-TR-77-117 ..... N78-12322 #
SAMSO-TR-77-137 ..... N78-12138 #
SAMSO-TR-77-193 ..... N78-12125 #
SAMSO-TR-77-194 ..... N78-12315 #
SAMSO-TR-77-195 ..... N78-12615 #
SAMSO-TR-77-196 ..... N78-12139 #

SAN/1140-1/3-VOL-3-APP ..... N78-12545 #

SAND-76-8262 ..... N78-12793 #
SAND-77-0105 ..... N78-12396 #
SAND-77-0177 ..... N78-12395 #
SAND-77-8006 ..... N78-12485 #
SAND-77-8010 ..... N78-12049 #

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SATR-1 ..... N78-12287 #
SATR-1 ..... N78-12328 #
SATR-1 ..... N78-12682 #

SB-6238(A)77C-219 ..... N78-12508*#

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SCIENTIFIC-1 ..... N78-12283 #
SCIENTIFIC-1 ..... N78-12331 #
SCIENTIFIC-8 ..... N78-12616 #

SCRC-CR-77-22 ..... N78-12269 #

SC579.4PR ..... N78-12804 #
SC5026.22TR ..... N78-12200 #

SDAC-TR-77-9 ..... N78-12619 #

SDC-TM-(L)-5903/000/00 ..... N78-12723 #

SE-8-PT-2 ..... N78-12623 #

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SEFC-CONTRIB-77-16 ..... N78-12500*#

SEMCOR-SK-JJK-75-125-1 ..... N78-12299 #

SGD-394-PT-1 ..... N78-12993 #
SGD-394-PT-2 ..... N78-12994 #

SI-TR-249 ..... N78-12766 #

SKYWATER-MONOGRAPH-1 ..... N78-12642 #
SKYWATER-MONOGRAPH-1-SUPP ..... N78-12643 #

SOL-77-14 ..... N78-12717 #

SORI-EAS-77-329 ..... N78-12562 #

SR-1 ..... N78-12286 #
SR-1 ..... N78-12324 #
SR-1-VOL-2 ..... N78-12348 #
SR-50-1977 ..... N78-12290 #

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SU-SOL-76-29 ..... N78-12708 #
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SU-SOL-77-7 ..... N78-12712 #
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TI-08-77-22 ..... N78-12328 #

TM-77-186 ..... N78-12250 #

TN-1977-7 ..... N78-12267 #
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TN-1977-30 ..... N78-12121 #
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TR-77-8-001 ..... N78-12710 #
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TR-555 ..... N78-12728 #
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TR-0077(2240)-4 ..... N78-12125 #
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UCB-ITS-SR-77-8-VOL-3 ..... N78-12539 #
UCB-ITS-SR-77-10-VOL-8 ..... N78-12538 #

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UCRL-52238 ..... N78-12622 #
UCRL-77305-REV-1 ..... N78-12242 #

UCSD-8236 ..... N78-12174 #

UDOT-MR-77-1 ..... N78-12257 #

UILU-ENG-77-1745 ..... N78-12292 #
UILU-ENG-77-2216 ..... N78-12871 #
UILU-ENG-77-2221 ..... N78-12276 #
UILU-ENG-77-2224 ..... N78-12680 #
UILU-ENG-77-2501 ..... N78-12585*#

UILU-WRC-77-0122-VOL-2 ..... N78-12522 #

UIUCDCS-R-77-870 ..... N78-12292 #
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UMTA-MA-06-0025-77-9 ..... N78-12397 #
UMTA-MA-06-0049-77-2 ..... N78-12903 #

UMTA-MD-06-0022-77-1 ..... N78-12906 #

US-PATENT-APPL-SN-612966 ..... N78-12390*

US-PATENT-CLASS-55-3 ..... N78-12390*
US-PATENT-CLASS-55-26-9 ..... N78-12390*
US-PATENT-CLASS-55-100 ..... N78-12390*
US-PATENT-CLASS-62-50 ..... N78-12390*
US-PATENT-CLASS-62-514R N78-12390*
US-PATENT-CLASS-137-197 ..... N78-12390*
US-PATENT-CLASS-210-222 ..... N78-12390*

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USGS-WRD-WRI-77-047 ..... N78-12912 #

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UTIAS-TN-211 ..... N78-12030 #

UTIAS-203 ..... N78-12473 #
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UTRC/R77-922295-5 ..... N78-12412 #
UTRC/R77-952595-1 ..... N78-12818 #

VPI-AERO-073 ..... N78-12048 #

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